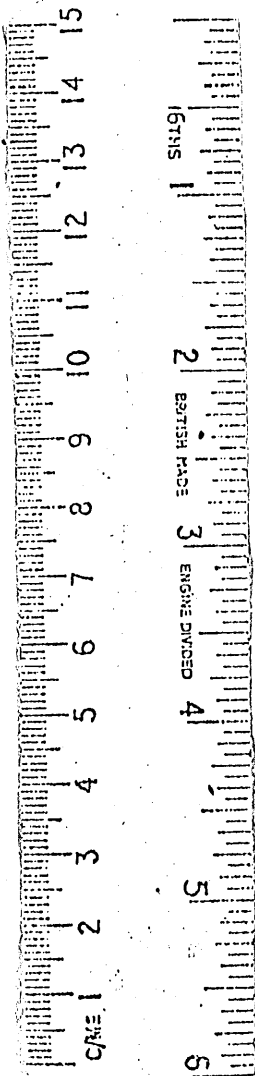


1st Seaman's Grammar.
 2^d Art of Dyalling.
 3^d Trithemium's tabularium.
 4th Merchant's Magazine.



THE
SEA-MAN'S
Grammar and Dictionary,

Explaining all the difficult **TERMS**
 in **NAVIGATION:**

AND THE PRACTICAL
Navigator and Gunner:
 In Two Parts.

Containing

- I. Most plain and easie Directions, to Build, Rigg, Yard, and Mast any **SHIP** whatsoever. With the manner of Working of a **SHIP** in all Weathers: — And how to manage a Fight at Sea: — Also the Charge and Duty of every Officer in a **Ship**, and their Shares: — And the use of the **PETTY-TALLY**.
- II. An Abstract of the Art of **GUNNERY** (or Shooting) in great **ORDNANCE** and **MORTER-PIECES**: — Wherein the Principles of that Art are plainly Taught both by Arithmetical Calculation, and by **TABLES** ready Calculated — With the Compositions for the making of several **FIRE-WORKS** useful in War both at **SEA** and **LAND**. — And an Appendix how by several Geometrical ways to take **Heights**, **Depths**, and **Distances**, Accessible or Inaccessible.

By Captain **JOHN SMITH**,
 Sometimes Governour of *Virginia*, and Admiral of *New England*.

Now much Amplified and Enlarged, with variety of Experiments, since his Time, made by several Experienced **NAVIGATORS** and **GUNNERS**.

LONDON: Printed for *Tho. Dring* and *B. Griffin*, and are to be Sold at the *Harrow* at *Chancery-Lane* end in *Fleetstreet*, 1692.

THE
P R I N T E R
TO THE
R E A D E R.
*And all worthy Adventurers by Sea, and
well-wishers to*
N A V I G A T I O N.

THere hath been much already written concerning the Art of War by Land, but nothing concerning the same at Sea; yet perceiving the present occasion to require something of that kind, I have adventured to bring again to remembrance, those excellent Precepts and Directions, long since published by Captain *John Smith*, which were almost worn out by time, and herein, if my desire to do good hath transported me beyond my self, I intreat your excuse, and take for requital this bundle of many Ages Observations: which although they be not so punctually compiled as the Author could have wished, and it may be you expect, yet at present they cannot be much amended; If any will bestow that pains, I shall think him my friend, and honour his endeavours.

And now (since it was the desire of the Experienced Author, to have this his Treatise amplified and made more useful,) I have, in this Edition, caused to be added, *An Alphabetical Table* of the Names of all the Parts
or



272.3.11

The Printer to the Reader.

or Members of a *Ship*, and its *Appurtenances*; with the number of the Page wherein they are at large Explained: And also, another *Alphabetical Table*, wherein the principal *Sea-Terms* used in working of a *Ship* in all *Winds* and *Weathers*, and also in a *Fight* at Sea, are largely discoursed and explained.

And to make this Treatise, yet more useful for Sea-service (especially in time of War) I have caused to be added also, an *Abstract* of the Art of *Practical Gunnery*; Wherein the Principles of that Art are plainly Taught both by *Arithmetical Calculation*, and by new *Tables* ready *Calculated*: Together with the manner of Shooting in *Mortar-Pieces*; The making of *Granados*, *Petards* and other *Fireworks* useful in War, both at Sea and Land: And by way of *Appendix*, several *Geometrical* ways, to take *Heights*, *Depths*, and *Distances*, accessible or inaccessible. All which are freely communicated for the benefit of his Country, and the good of Navigators and Gunners:

And as I shall find these *Essays* of mine accepted, I shall be encouraged farther to accommodate them with the *Mathematical* part of *Navigation*.

B. N.



THE CONTENTS Of the Grammar.

	Folio
OF Docks and their definitions, and what belongs to them, Chap. 1.	1
How to build a Ship, with the definition of all the principal names of every part of her, and her principal timbers, also how they are fixed one to another, and the reasons of their use. Chap. 2.	2
How to proportion the Masts and Yards for a Ship, by her Beam and Keel Ch. 3.	15
The names of all the Masts, Tops and Yards belonging to a Ship. Chap. 4.	17
How all the Tackling and Rigging of a Ship is made fast one to another, with the Names and Reasons of their use. Chap. 5.	18
What doth belong to the Boats and Skiff, with the definition of all those thirteen Ropes, which are only properly called Ropes belonging to a Ship or a Boat, and their use. Chap. 6.	26
The names of all sorts of Anchors, Cables and Sails, and how they bear their proportions, with their use. Also how the Ordnance should be placed, and the Goods stowed in a Ship. Chap. 7.	29
The charge and duty of the Captain of a Ship, and every Office and Officer in a man of War. Chap. 8.	34
Proper Sea-terms for dividing the Company at Sea, and steering, falling and mooring a Ship in fair weather or in a storm. Chap. 9.	37
Proper Sea terms for the Winds, Ebbs, Floods, and Eddies, with their definitions, and an estimate of the depth of the Sea, by the height of the Hills and largeness of the Earth. Chap. 10.	46
Proper Sea-terms belonging to the good or bad condition of Ships, how to find them and amend them. Chap. 11.	52
Considerations for a Sea-Captain in the choice of his Ship, and in placing his Ordnance: In giving Chase, Boarding, and entering a man of War like himself, or defending a Merchant-man. Chap. 12.	54
	How

The Contents of the Grammar.

How to manage a Fight at Sea, with the proper terms in a Fight largely expressed, and the ordering a Navy at Sea.	Chap. 13.	59
How they divide their shares in a man of War, what Books and Instruments are fit for a Sea-man, with divers advertisements for young Gentlemen that intend to follow the Sea, and the use of the Petty Tally.	Chap. 14.	63
An Alphabetical Table of the Names of all the Parts or Members of a Ship, and its Appurtenances, with the Number of the Page in which the Term, (or Word) there form'd, is Explained at Large.	Chap. 15	67
Another Alphabetical Table, Explaining all the Principal Sea Terms used in work of a Ship, in all Winds and Weathers.	Chap. 16.	74

The



THE CONTENTS Of Gunnery.

	Folio
Wherein is declared the Names of all sorts of Ordnance, and their Appurtenances, with an Explanation of their proper Terms; and divers Observations concerning Shooting in them.	Chap. 1. 85
How a Gunner ought to be Qualified.	Chap. 2. 90
Of such Necessary Implements and Instruments as a Gunner that hath charge of Guns or Artillery ought to be furnished with.	Chap. 3. 91
Cautions that a Gunner ought to observe before he fire his Gun.	Chap. 4. 92
Of Gunpowder, and how it hath been made from time to time, and how it is made at this present.	Chap. 5. 93
Of the Names of the several parts or members of a Piece of Ordnance.	Chap. 6. 93
Of the several Pieces of Ordnance now in use.	Chap. 7. 95
How to find the Diameter of any Round Shot or Buller, by knowing the Circumference: Or, By having the Circumference of a Shot, to find the Diameter.	Chap. 8. 97
A Table shewing how to find the Diameter of any Circle or Ring of a Gun not exceeding 34 Inches: Of excellent use for the ease and exact finding of the length of the Dispart of any Gun: As also of the Diameter of any Shot or Buller: without Callopers, and also of Granado-Shells.	Chap. 9. 100
Concerning the Disparting of any Piece of Ordnance, and how to find the length of the Dispart.	Chap. 10. 103
How to know whether a Piece of Ordnance be truly bored or not, when it is in its Carriage: and lying Horizontally.	Chap. 11. 106
Concerning Guns that are not truly bored; How to know what quantity of Powder must be allowed for their Loading.	Chap. 12. 108
How to discover what Cracks, Flaws, or Honeycombs are in any Piece of Ordnance.	Chap. 13. 109
Concerning the Weight of Iron-shot, and Granado-Shells.	Chap. 14. 110
Concerning the following Table of Cube-Roots.	Chap. 15. 114
Concerning	

The Contents of Gunnery.

Concerning the Proportion of the Weights of Iron, Lead, Stone, &c. And how by knowing the Weight of one Shot of Lead, to find the Weight of another of the like Diameter of Iron or Stone. Chap. 16.	124
Concerning Gunpowder, and to find what quantity will fill any Granado-Shell or Cartridge. Chap. 17.	126
Concerning the Allowance of Powder for the Charge of any well Fortified Gun either Brass or Iron, according to the Weight thereof, from one hundred to ninety hundred Weight of Metal. Chap. 18.	128
Concerning Cartridges, how to make them, and fit them, fitting for the Bore, or Chamber of any Piece of Ordnance. Chap. 19.	130
Concerning Carriages for Pieces of Ordnance, and how they should be made. Chap. 20.	133
Concerning Shooting in great Ordnance, and how to Load your Gun Artificially, either with Powder or Cartridge. Chap. 21.	134
How to give Level with a Piece of Ordnance to make a Shot at any mark within Point blank. Chap. 22.	135
Shewing how to amend a Shot, which (by some accident) doth carry over, under, or wide of the Mark intended. Chap. 23.	135
Concerning a Gunner's Ruler, for the Elevating of any Piece of Ordnance to any degree of Mounture, supplying the use of the Gunner's Quadrant. Chap. 24.	129
A Table, and the Use thereof, whereby you may give Level to a Piece of Ordnance, without the Gunners Rule or Quadrant, to any degree of Mounture under eleven degrees. Chap. 25.	133
Concerning Shooting at Random. Chap. 26.	135
How you may make a good at your Enemies Light in a dark night. Chap. 27.	139
How to make a perfect Shot in a dark night, at any mark (within the reach of the Piece) that you can see in the day time. Chap. 28.	139
How to make a good Shot at a Company of Souldiers passing by; or at a Ship sailing up a River. Chap. 29.	140
Some Reasons, Why one and the same Piece of Ordnance at the same Elevation, charged with the same quantity of Powder, and directed to the self same Mark, and discharged several times, shall have different Rainges. Chap. 30.	140
Concerning Shooting in a Morter-Piece, and of several Fire-Works, both for Sea and Land Service. Chap. 31.	142
The Measuring of Heights, Depths, and Distances, &c.	152

The

27 The Trens Bowsprit
26 The Spirit of
25 The Spirit of

B

certain the Stockes.

Iry-Dock.

ver-Dock.

Cradle.

The Contents of Gunnery.

A Description of a Ship with all her Tackling.

Mizan Mast And running Rigging.

Main Mast and running Rigging.

- 1 Mizan Mast & Top-mast.
- 2 Mizan Yard and Sail.
- 3 The Cross tree yard.
- 4 Mizan Topfail yard and Sail.
- 5 Mizan Top and Cap.
- 6 Mizan Topfail Lifts.
- 7 Mizan Topfail Sheets.
- 8 Mizan Shrowds.
- 9 Mizan Topmast Shrowds.
- 10 Mizan Chains.
- 11 The Gallery.
- 12 Taffrail. (Ensign.
- 13 The Cap Ensign-staff and
- 14 The Quarter Deck.
- 15 The half Deck.
- 16 The Mizan Sheet.
- 17 Mizan Topfail Braces.
- 18 Mizan Topfail Bowlines.
- 19 Mizan Topfail Clewlines.
- 20 Mizan Bratles.
- 21 Mizan Topmasts Stay.
- 22 Mizan Stay.
- 23 Mizan Sheet.
- 24 Yards & Oars for the Boat
- 25 The Ships Boat.
- 26 A hoistingline for Pennant.
- 27 Mizan Bowlin.
- 28 A Mizan Crowfoot.
- 29 Cross tree Braces.
- 30 Mizan Tack.
- 31 The Laniards.
- 32 The Mizan Topmast Crow-
- foot.

- 1 Main-mast & main Topmast.
- 2 Main yard and Main Sail.
- 3 Main Topfail yard and Sail.
- 4 Topgallant yard and Sail.
- 5 Topgallant Cross-trees & Cap
- 6 Main Lifts.
- 7 Main Topfail Lifts.
- 8 Topgallant Lifts.
- 9 Main Braces.
- 10 Main Sheets.
- 11 Main Bowlings.
- 12 Main Clew-garnets.
- 13 Main Stay.
- 14 Main Shrowds. (Plaits.
- 15 Main Chains and Chain-
- 16 Backstays for the main Top-
- Mast.
- 17 Main Topmast Stay.
- 18 Main Topfail Braces.
- 19 Main Topfail Clewlines.
- 20 Main Topfail Bowlines.
- 21 Main Topmast Shrowds.
- 22 Main Topgallant Shrowds.
- 23 Topgallant Clewlines.
- 24 Topgallant Braces.
- 25 Topgallant Bowlines.
- 26 The horse for the main Top-
- sail yard.
- 27 Main Topfail Leathlines.
- 28 Main Topfail Buntlines.
- 29 A Crowfoot from the Top to
- the Stay.
- 30 Main Tack.
- 31 Main Sheets. (Garnet.
- 32 The main Tye and fall of the

- 33 The main Horse & Tackle.
- 34 The ke of the main Topfail
- Feer.
- 35 The main Topgallant Sails
- Tye and Feers.

Foremast & rigging.

- 1 Foremast and Topmast.
- 2 Fore yard and Sail.
- 3 Fore Topfail yard and Sail.
- 4 Topgallant yard and Sail.
- 5 Fore Lifts.
- 6 Fore Topfail Lifts.
- 7 Fore Topgallant Lifts.
- 8 Cross-trees and Cap.
- 9 Fore Braces.
- 10 Fore Topfail Braces.
- 11 Fore Topgallant Braces.
- 12 Fore Sheets and Tacks.
- 13 Fore Bowlines.
- 14 Fore Topfail Bowlines.
- 15 Fore Topgallant Bowlines.
- 16 Fore Clew-garnets.
- 17 Fore Topfail Clewlines.
- 18 Fore Shrowds.
- 19 Fore Topmast Shrowds.
- 20 Fore Topgallant Shrowds.
- 21 Fore Stay.
- 22 Fore Topmast Stay.
- 23 Fore Topgallant Stay (yard
- 24 Horse for the fore Topfail
- 25 Fore Topgallant Clewlines.
- 26 Fore Topmast Backstays.
- 27 Fore Chains and Plaits.
- 28 Fore Topfail Leathlines.
- 29 Fore Topfail Buntlines.
- 30 Fore Leathlines.
- 31 Fore Buntlines.

- 32 The Fore Topfails Tye and
- Feer.
- 33 The Yard of the fore Topfail.
- 34 The Fore Horse and Tackle.
- 35 The foretop Gallantsails Tye
- and Feer.
- 36 The Fore Tack.

The Bowsprit and Rig-

- 1 Bowsprit.
- 2 Spritsail yard and Sail.
- 3 Spritsail Top and Cross-trees
- 4 Spritsail Topfail yard & fail.
- 5 Spritsail Topmast.
- 6 Spritsail Sheets. (sail yard:
- 7 Standing Lifts for the Sprit-
- 8 Spritsail Braces.
- 9 Spritsail Sheets.
- 10 Spritsail Clewlines.
- 11 Spritsail Topfail Braces.
- 12 Spritsail Topfail Lifts.
- 13 Spritsail Topmast Shrowds.
- 14 Jack Staff and Jack.
- 15 The Ships Head.
- 16 The Cat Head.
- 17 The Harpers.
- 18 The fore Castle.
- 19 The Grain line.
- 20 The Horse on the Bowsprit.
- 21 Steps on the side.
- 22 The main Spritsail (Feers.
- 23 The main Spritsail Tye &
- 24 The Spritsail Topfail Clew-
- lines.
- 25 The Spritsail Topfail Cri
- 26 The Spritsail Topfail Cri
- 27 The Trans Bowsprit.



THE
SEAMANS
GRAMMAR and DICTIONARY;
OR THE
PRACTICAL
NAVIGATOR and GUNNER.

In Two Books

CHAP. I.

Of Docks, and their definitions.



DOCK is a great pit or pond, or Creek by a Harbour side, made convenient to work in, with two great flood gates built so strong and close, that the Dock may be dry till the ship be built or repaired, and then being opened, let in the water to float and lanch her, and this is called a **dry Dock**. A **wet Dock**

A dry-Dock.

A wet-Dock.

is any place where you may hale in a ship into the oze out of the tides way, where she may dock her self. A **Cradle** is a frame of timber, made along a ship, or the side of a Galley by her billidge, for the more ease and safety in lanching, much used in *Turkey*, *Spain*, and *Italy*. And the **Stockes** are

A Cradle.

The Stockes.

certain framed posts, much of the same nature upon the shore to build a Pinnace, a Catch, a Frigate, or Boat, &c. To those Docks for building belongs their Wood-yards, with Saw-pits and all sorts of timber; but the Masts and Yards are chained together in some greater water to keep them from rotting, and in season: Also a **Crab** is necessary, which is an Engine of wood of three claws placed on the ground in the nature of a Capstern, for the launching of ships or heaving them into the Dock.

Crab.

CHAP. II.

How to build a Ship, with the definitions of the names of every part of her Principal Timbers, and how they are fixed one to another, with the reasons of their use.

The Keel.

THe first and lowest Timber in a ship is the **Keel**, to which is fastened all the rest; this is a great tree or more, hewn to the proportion of her burden, laid by a right line in the bottom of the Dock, or Stocks. At the one end is skarfed into it the **Stem**, which is a great timber wrought compassing, and all the butt-ends of the planks forwards are fixed to it. The **Stern post** is another great Timber, which is let into the Keel at the other end somewhat sloping, and from it doth rise the two **fashion-pieces** like a pair of great horns, to those are fastened all the planks that reach to the after end of the Ship, but before you use any planks, they lay the **Rungs**, called floor timbers, or ground timbers, thwart the keel: thro' those you cut your **Limberholes** to bring the water to the well for the pump, the use of them is when the Ship is built to draw in them a long hair rope, by pulling it from Stern to Stem, to scowre them, and keep them clean from choaking.

Those

The Stem.

The Stern.

The fashion-pieces.

The Rungs:

The Limber-holes.

Those ground timbers do give the **Floor** of the Ship, being straight, saving at the ends they begin to compass, and there they are called the **Rungheads**, and doth direct the **Sweep** or **Mould** of the Foot-hooks and Navel timbers, for there doth begin the compass and bearing of the Ship, those are **Skarfed** into the ground Timbers, which is one piece of wood let into another, or so much wood cut away from the one as from the other, for when any of those Timbers are not long enough of themselves, they are skarfed in this manner, to make two or three as one: Those next the Keel are called the ground Foot-hooks, the other the upper Foot-hooks; but first lay your **Keelson** over your floor Timbers, which is another long tree like the **Keel**, and this lying within as the other without, must be fast bound together with strong iron bolts thorow the Timbers and all, and on those are all the upper works raised, when the **Foot-hooks** are skarfed as is said, and well boulded, when they are planked up to the Orlop they make the Ship **Hole**, and those Timbers in general are called the Ships **Ribs**, because they represent the carcass of any thing that hath **Ribs**. The **Sleepers** run before and after one each side the Keelson, on the floor well bolted to the Foot-hooks, which being thus bound do strengthen each other. The **Spurkits** are the spaces betwixt the Timbers alongst the Ship side in all parts, but them in **Howle** below the Sleepers, are broad boards which they take up to clear the Spurkits, if any thing get betwixt the Timbers.

The **Garboard** is the first plank next the Keel on the outside, the **Garboard-Strake** is the first seam next the Keel, your **Rising timbers** are the hooks, or ground timbers and foot-hooks placed on the Keel, and as they rise by little and little, so doth the **Run** of the Ship from the floor, which is that part of the Ship under water, which comes narrower by degrees from the floor timbers along the stern post, called the Ships way astward, for according to her run she will steer well or ill, by reason of the quickness or slowness of the water coming to the Rudder: Now all those

B 2

planks

The Floor.

Rungheads.
Sweep.
Mould.
Skarfing.Foot-hooks.
Keelson.Howle:
Ribs.
Sleepers.

Spurkits.

The Garboard
Garboard-strake.
Rising-timbers.

The Run.

Planks. planks under water, as they rise and are joyned one end to another, the fore end is called the **But-end** in all Ships: but in great Ships they are commonly most carefully bolted, for if one of those ends should spring, or give way, it would be a great troublesome danger to stop such a leak, the other parts of those planks are made fast with good **Tree-nails** and **Trunnions** of well seasoned Timber, thorow the Timbers or Ribs, but those planks that are fastened into the Ship Stern are called **Whoodings**.

Tree-nails.
Trunnions.
Whoodings.
The Tuck. The gathering of those works upon the Ships quarter under water is called the **Tuck**, if it lie too low it makes her have a fat quarter, and hinders the quick passage of the water to the Rudder; if too high, she must be laid out in that part, else she will want bearing for her after-works. The **Transome** is a Timber lies thwart the Stern, betwixt the two fashion-pieces, and doth lay out the breadth of the Ship at the **Buttocks**, which is her breadth from the Tuck upwards, and according thereto her breadth or narrowness, we say she hath a narrow or broad Buttock: The fashion-pieces before spoken of, are the two outmost timbers on either side the Stern, excepting the **Counters**. The Ships **Rake** is so much of her **Hull** as hangs over both ends of the Keell, so much as is forward is said, she rakes so much forward, and so in like manner aftward; by the Hull is meant, the full bulk or body of a Ship without masts or any rigging from the Stern to the Stern: The Rake forward is near half the length of the Keell, and for the Rake aftward about the forepart of the Ship good way, and makes her keep a good wind, but if she have not a full Bow, it will make her pitch her head much into the Sea; if but a small Rake forward, the Sea will meet her so fast upon the Lowes, she will make small way, and if her Stern be upright as it were, she is called **Bluffe**, or **Bluffe-headed**. A Ship **Billage** is the breadth of the floor when she doth lie aground, and Billage-water is that which cannot come to the pump, we say also she is bilged when she strikes on a Rock, an Anchors Floor, or any thing

Bluffe.
Bluffe-headed
Billage.

thing that breaks her Planks or Timbers to spring a Leak.

When you have berthed or brought her up to the **Planks**, which are those thick Timbers which goeth fore and aft on each side, whereon doth lie the beams of the first **Orlop**, which is the first floor to support the Planks, doth cover the **Howle**, those are great cross-timbers, that keeps the Ships-sides afunder; the main beam is ever next the main Mast, where is the Ships greatest breadth, the rest from this is called the first, second, third, fourth, &c. forward or aftward **Beams**. Great Ships have a tire of Beams under the Orlop, whereon lies no Deck, and great posts and binders called **Riders** from them to the Keel in Howle only to strengthen all. But the beams of the Orlop is to be bound at each end with sufficient **Lines**, which is a crooked piece of wood bowed like a **Knee**, that binds the Beams and Foot-hooks, being bolted together, some stand right up and down, some along the Ship, and are used about all the Decks, some sawed or hewed to that proportion, but them which grow naturally to that fashion are the best.

Lay the Orlop with good Plank, according to her proportion, so level as may be, is the best in a Man of War, because all the **Ports** may be of such equal height, so that every Piece may serve any Port, without making any **Beds** or Platforms to raise them, but first bring up your work as before to the second Deck or Orlop, and by the way you may cut your number of Port-holes according to the greatness of your Ship; by them fasten your **Ring-bolts**, for the Tackles of your Ordnance you use Ringbolts also for bringing the Planks and Walls to the Ship-side, and **Set-bolts** for forcing the Works and Planks together: **Clinch-bolts** are clinched with a riveting hammer for drawing out. But **Flag-bolts** are so jagged that they cannot be drawn out. **Fore-lock bolts** hath an eye at the end, whereinto a Fore-lock of Iron is driven to keep it from starting back. **Fend-bolts** are beat into the outside of a Ship, with the long head to save her sides from galling against other Ships. **Drive-bolts** is a long piece of Iron to drive out a Tree-nail, or any such

such things, besides divers others so useful that without them and long Iron-spikes and Nails nothing can be well done; yet I have known a Ship built, hath failed to and again over the main Ocean, which had not so much as a Nail of Iron in her, but only one Bolt in her Keel.

She was built
of Cedar.

Clamps.

Now your risings are above the first Orlop as the **Clamps** are under it, which is long thick Planks like them, fore and aft on both sides, under the ends of the Beams and Timbers of the second Deck or Orlop, or the third Deck or Orlop, or the third Deck which is never called by the name of Orlop, and yet they are all but Decks; also the **half-Deck** and **Quarter-Deck**, whereon the Beams and Timbers bear, are called risings. A **stush Deck** is when from Stem to Stern, it lies upon a right line fore and aft, which is the best for a Man of War, both for the men to help and succour one another as for the using of their arms, or remounting any dismounted Piece, because all the Ports on that Deck are on equal height, which cannot be without Beds and much trouble, where the **Deck doth camber** or lie compassing. To **sink a Deck** is a to lay it lower, to **raise a Deck** to put it higher, but have a care you so cut your Port-holes, that one piece lie not right over another for the better bringing them to your mark.

Decks.
A half Deck.
A Quarter-
Deck.
A stush Deck.

A Cambered
Deck.
To sink a Deck
To raise a
Deck.

The half Deck is from the main Mast to the Steerage, and the Quarter-Deck from that to the Masters Cabin called the Round House, which is the utmost of all, but you must understand all those Works are brought up together, as near equally as may be from **bend to bend**, or **waile to waile**, which are the outmost Timbers on the Ship-sides, and are the chief strength of her sides, to which the Foot-hooks, Beams and Knees, are bolted, and are called the first, second, and third Bend; but the **Chain-waile** is a broad timber set out amongst them, a little above where the Chains and Shrouds are fastned together, to spread the Shrouds the wider, the better to succour the Masts. Thus the Sides and Decks are wrought till you come at the **Gun-waile**, which is the upmost waile, goeth about the upmost frake or scame of the upmost Deck about the **Ships waile**, and the **Ships Quarter** is from the main Mast astward.

Bend, or waile.

Chain-waile.

Gun-waile.

The Ships
Quarters.

Culver-tailed is letting one Timber into another, in such sort that they cannot slip out, as the **Carling** ends are fixed in the Beams, and Carlings are certain Timbers lieth along the Ship from beam to beam, on those the ledges do rest, whereunto the Planks of the Decks are fastened. The **Carling-knees** are also timbers comes thwart the Ship from the sides of the Hatches way, betwixt the two Masts, and bears up the Deck on both sides, and on their ends lieth the **commings** of the Hatches, which are those Timbers and Planks which bears them up higher than the Decks, to keep the water from running down at the Hatches; also they fit **Loopholes** in them for the close sights, and they are likewise a great ease for men to stand upright if the Decks be low. The **Hatches way** is when they are open where the Goods are lowered that way right down into the **howle**, and the **Hatches** are like Trap-doors in the midst of the Decks, before the Main-Mast, by certain Rings, to take up or lay down at your pleasure.

Culver-tailed,
Carlings.

Carling-knees.

Commings.

Loopholes.

Hatches way.

A **Scuttle hatch** is a little Hatch doth cover a little Square-hole we call the Scuttle, where but one man alone can go down into the Ship, they are in divers places of the Ship whereby men pass from Deck to Deck, and there is also small Scuttles Grated, to give light to them betwixt Decks, and for the smoak of the Ordnance to pass away by. The **Ramshhead** is a great Block wherein is three shivers, into which are passed the Halyards, and at the end of it in a hole is reved the ties, and this is only belonging to the fore-end Main Halyard; to this belong the **fore-knight**, and the **main-knight**, upon the second Deck fast bolted to the Beams. They are two short thick pieces of wood, commonly carved with the head of a man upon them, in those are four shivers apiece, three for the Halyards, and one for the top-rope to run in: and **knevels** are small pieces of Wood nailed to the inside of the Ship, to belay the Shears and Racks unto.

A Scuttle.

Ramshhead.

The fore-
Knight,
The main-
Knight.

Knevels.

The **Capstaine** is a great piece of Wood, stands upright upon the Deck, abaft the main Mast, the foot standing in a step

Capstaine.

Capstain-Bars.

The Spindle.
Whelps.

Paul.

Jeare Capstain

The Viol.

A Windas.

The Pump.
The Brake.
The Can.The Dail.
Chained.
Pumps.

A Bur-Pump.

step upon the lower Deck, and is in the nature of a Windis, to wind or weigh up the Anchors, Sails, Tap-masts, Ordnance, or any thing; it is framed in divers Squares, with holes thorow them, thorow which you put your **Capstain Bars**, for as many men as can stand at them to thrust it about, and is called manning the Capstain. The main body of it is called the **Spindle**. The **Whelps** are short pieces of wood made fast to it; to keep the Cable from coming too high in the turning about. The **Paul** is a short piece of Iron made fast to the Deck, resting upon the Whelps to keep the Capstain from recoiling, which is dangerous, but in great Ships they have two, the other standing in the same manner betwixt the fore-mast and the main, to heave upon the Jeare-rope, and is called the **Jeare Capstain**, to strain any Rope, or hold off by, when we weigh Anchor, to heave a head, or upon the Viol, which is when an Anchor is in stiff ground we cannot weigh it, or the Sea goeth so high the main Capstain cannot purchase in the Cable, then we take a Hawser opening one end, and so puts into it Nippers some seven or eight fathom distant from each other, wherewith we bind the Hawser to the Cable, and so brings it to the Jeare Capstain to heave upon it, and this will purchase more than the main Capstain can. The **Dioll** is fastened together at both ends with an eye or two, with a Wall-knot, and sealed together. A **Windas** is a Square piece of Timber like a Role before the fore Castle in small Ships, and forced about with handspikes, for the same use as is the Capstain.

What are the parts of a **Pump** you may see in every place, the handle we call the **Brake**, the Pumps **Can** is a great **Can** we pour water into Pumps to make it pump. The **Dail** is a Trough wherein the water doth run over the Docks: But in great Ships they use **chained Pumps** which will go with more ease, and deliver more water. The **Dutch** men use a **Burre Pump** by the Ship-side, wherein is only a long staffe with a Burre at the end, like a Gunners Sponge, to pump up the Billage water, that by reason of the breadth of the Ships floor cannot come to the Well: In pumping

pumping they use to take spels, that is, fresh men to relieve them, and count how many strokes they pump each watch, whereby they know if the Ship be stanch, or tight, or how her Leaks increase. The **Pump sucks** is when the water being out, it draws up nothing but froth and wind. They have also a little Pump made of a Cane, a little piece of hollow wood or Latten like an Elder-gun, called a **Bare Pump**, to Pump the Beer or Water out of the Cask, for at Sea we use no Taps, and then stave the Cask to make more room, and packeth the Pipe-staves or boards up as close as may be in other Cask till they use them.

The **Skuppers** are little holes close to all the Decks thorow the Ships sides, whereth the water doth run out when you pump or wash the Decks: the **Skupper-leathers** are nailed over those holes upon the lower Deck to keep out the Sea from coming in, yet give they way for it to run out: **Skupper-nails** are little short ones with broad heads, made purposely to nail the Skupper-leathers, and the cotes of Masts and Pumps. The **Waist** is that part of the Ship betwixt the main Mast and the Fore-castle, and the **Waist-boards** are set up in the Ships Waist, betwixt the Gun-waile and the **Waist-truss**, but they are most used in Boats, set up alongst their sides to keep the Sea from breaking in.

There are usually three **Ladders** in a Ship: the **entering Ladder** is in the Waist, made formally of wood, and another out of the **Gallery** made of Ropes to go into the Boat by in foul weather, and the third at the Beak-head, made fast over the **Boultspret** to get upon it, only used in great Ships.

It were not amiss now to remember the **Fore-castle**, being as useful a place as the rest, this is the forepart of the Ship above the Decks over the **Bowe**, there is a broad Bowe and a narrow Bowe, so called according to the broadness or the thinness: the Bowe is the broadest part of the Ship before, compassing the Stem to the **Moufe**, which reacheth so far as the Bulk head of the Fore-castle extendeth. Against the

The Pump-suck.

A Bare-Pump.

The Skupper.

Skupper-leathers.

Skupper-nails.

The Waist.

Waist-boards.

Waist-truss.

The entering-Ladder.

Gallery-Ladder.

Boultspret-Ladder.

The Fore-castle.

Bowe.

Loufe.

Bowe

Cut a Feather.

Bowe is the first breach of the Sea, if the Bowe be too broad, she will seldom carry a bone in her mouth, or **cut a feather**, that is, to make a fume before her: where a well bowed Ship so swiftly presseth the water, as that it foameth, and in the dark night sparkleth like fire. If the Bowe be too narrow, as before is said, she pitcheth her head into the Sea, so that the mean is the best if her after-way be answerable. The

Hauses.

Hauses are those great round holes before, under the Beak-head, where commonly is used the Castles when you come to an Anchor, the bold or high Hause is the best, for when they lie low in any great Sea, they will take in very much water, the which to keep out, they build a circle of Plank either abaft or before the main Mast called the **Manger**: and a Hause-plug at Sea, now the Fore-castle doth cover all those being built up like a half Deck, to which is fixed the Beak-head, and the **Prow** is the Deck abaft the fore-castle, whereon lieth the Prow-pieces.

Prow.

The Beak-head.

The **Beak-head** is without the Ship before the fore-Castle, supported by the main knee, fastened into the Stem, all painted and carved as the Stern, and of great use, as well for the grace and countenance of the Ship, as a place for men to ease themselves in. To it is fastened the Coller of the main stay, and the fore-tacks there brought aboard: also the standing for rigging and trimming the Spruce-sail-gears, under the midst of it is the **Comb**, which is a little piece of wood with two holes in it to bring the fore tacks aboard. The **Bits** are two great pieces of Timber, and the

Combe.

Bits.
Crospieces.

Crospiece goeth thorough them, they are ordinarily placed abaft the Manger in the Ships loofe, to belay the Cable thereto when you ride at Anchor: Their lower parts are fastened to the Riders, but the middle part in great Ships are bolted to two great Beams cross to the Bowes, and yet in extraordinary storms we are glad to make fast the Cable to the main Mast for strengthening of the Bits and safeip of the Bowes, which have in great storms been torne from the Ships. The **David** is a short piece of Timber, at the end whereof in a notch they hang a block in a strap called the

Fish-

Fish-block, by which they hale up the flook of the Anchor to the Ships Bowe, it is put out betwixt the Cat and the Loofe, and to be removed when you please. The **Cat** is also a short piece of timber aloft, right over the Hause; in the end it hath two shivers in a block, wherein is reaved a Rope, to which is fastened a great hook of Iron, to trice up the Anchor from the Hause to the top of the Fore-castle.

Fish-block.

Cat.

A **Bulk-head** is like a feeling or a wall of boards thwart the Ship, as the Gun-room, the great Cabin, the bread room, the quarter-Deck, or any other such division; but them which doth make close the Fore-castle, and the half Deck, the Mariners call the **Cubbridge-heads**, wherein are placed murderers, and abaft Falcons, Falconets, or Robinites to clear the Decks fore and aft so well as upon the Ships sides, to defend the Ship and offend an enemy. **Sockets** are the holes wherein the Pintels of the Murderers or Fowlers go into. The hollow Arching betwixt the lower part of the Gallery and the Transome, is called the **lower Counter**; the **upper Counter** is from the Gallery to the Arch of the round House, and the **Brackets** are little carved Knees to support the Galleries.

A Bulk-head.

Cubbridge-head.

Sockets.

Low Counter.

Upper Counter

Brackets.

The **Stearage** room, is before the great Cabin, where he that steareth the Ship doth always stand, before him is a square Box nailed together with Wooden Pins, called a **Bittacle**, because Iron-nails would attract the Compass, this is built so close, that the Lamp or Candle only sheweth light to the Stearage, and in it always stands the **Compass**; which every one knows is a round Box, and in the midst of the bottom a sharp Pin called a Centre whereon the Fly doth play, which is a round piece of Past-board, with a finall wyer under it touched with the Load-stone, in the midst of it is a little bras Cap that doth keep it level upon the Center. On the upper part is painted 32 points of the Compass covered with Glas to keep it from dust breaking, or the wind; this Box doth hang in two or three bras Circles, so fixed they give such way to the moving of the Ship that still the Box will stand steady; there is also a **dark Com-**

The Stearage.
Great Cabin.

Bittacle.

The Compass.

A dark Com-
pass:
A Compass
for Variation.
The Trava.

The Whip-
staffe.

The Rowle.

The Tiller,
Rudder.

Pintels,
Gudgeons, or
Rudder-Irons.
The Gun-
room.
Cat-holes.

Lockers.

The Bread-
room.
Cook-room.

Stern.

pass, and a **Compass** for the variation, yet they are but as the other, only the dark Compass hath the Points black and white, and the other only touched for the true North and South. Upon the **Bittacle** is also the **Crab**, which is a little round board full of holes upon Lines like the Compass, upon which by the removing of a little stick they keep an account, how many Glasses (which are but half-hours) they steer upon every point. The **Whip-staffe** is that piece of wood like a strong staffe the Steersman or Helmsman hath always in his hand, going thorough the **Rowl**, and then made fast to the Tiller with a Ring.

The **Tiller** is a strong piece of wood made fast to the **Rudder**, which is a great timber somewhat like a Plank, made according to the burthen of the Ship, and hung at the Stern upon Hooks and Hinges, they call **Pintels** and **Gudgeons**, or **Rudder-irons**. The Tiller playeth in the **Gun-room** over the Ordnances by the Whip-staff, whereby the Rudder is so turned to and fro as the Helmsman pleases, and the **Cat-holes** are over the Ports, right with the Capstain as they can, to heave the Ship a Stern by a Cable or a Hauser called a Stern-fast. On each side the Steerage-room are divers Cabins, as also in the great Cabin, the quarter Deck, and the Round-house, with many convenient Seats or **Lockers** to put any thing in, as in little Cupboards.

The **Bread-room** is commonly under the Gun-room, well dried or plated. The **Cook-room** where they dress their Victuals may be placed in divers places of the Ship, as sometimes in the Hold, but that oft spoileth the victuals by reason of the heat, but commonly in Merchant-men it is the Fore-castle, especially being contrived in Furnaces; besides in chase their **Stern** is that part of the Ship they most use in fight, but in a Man of War they fight most with their Prow, and it is very troublesome to the use of his Ordnance, and very dangerous lying over the Powder-room, some do place it over the Hatches way, but that as the **Stewards room** are ever to be contrived according to

to the Ships employment, &c. **Calking** is beating **Okum** into every seam or betwixt Plank, and Plank, and **Okum** is old Ropes torn in pieces like Towze Match, or Hurds of Flax, which being close beat into every seam with a **Calking-Iron** and a Mallet, which is a hammer of wood and an Iron chissel, being well **Payed** over with hot pitch, doth make her more tight then it is possible by joyning Plank to Plank. **Graving** is only under water, a white mixture of Tallow, Sope and Brimstone; or Train-oil, Rosin, and Brimstone boiled together, is the best to preserve her calking, and make her glib or slippery to pass the water; and when it is decayed by weeds, or **Barnacles**, which is a kind of fish like a long red worm, will eat thorough all the Planks if she be not sheathed, which is as casing the Hull under water with Tar, and Haire, close covered over with thin boards fast nailed to the Hull, which though the Worm pierce, she cannot endure the Tar; **Breaming** her, is but washing or burning of all the filth with reeds or broom, either in a dry-dock or upon her **Carrene**; which is, to make her so light as you may bring her to lie on the one side so much as may be in the calmest water you can, but take heed you overset her not; and this is the best way to breame Ships of great Burthen, or those have but four sharp Flores for fear of bruising or oversetting **Partling** is most used upon the Decks and half Decks; which is, to take a list of Canvas so long as the seam is you would parfle, being first well calked, then pour hot pitch upon it, and it will keep out the water from passing the seams. There remains nothing now as I can remember to the building the Hull of the Ship, nor the definition of her most proper terms, but only feeling the Cabins and such other parts as you please, and to bind an end with all things fitting for the Sea, as you may read in the Covenants betwixt the Carpenter and the Owner, which are thus;

If you would have a Ship built of 400 Tuns, she requires a plank of 4 inches: if 300 Tuns, 3 inches: small Ships 2 inches, but none less. For clamps, middle bands, and sleepers,

Calking.
Okum.

Calking-Iron.
Paying.

Graving.

Barnacles,
or Wormes.

Brooming or
Breaming.
Carrene.

Partling.

pers, they be all of six inch plank for binding within. The rest for the sparring up of the works of square three inch plank. Lay the beams of the Orlope, if she be 400 Tuns at ten foot deep in howle, and all the beams to be bound with two knees at each end, and a stardard knee at every beams end upon the Orlope, all the Orlope to be laid with square three inch plank, and all the planks to be tree-nailed to the beams.

Six foot should be between the beams of the Deck and Orlope, and ten ports on each side upon the lower Orlope, all the binding between them should be with three inch or two inch plank, and the upper Deck should be laid with so many beams as are fitting, with knees to bind them, laying that Deck with spruce Deal of thirty foot long; the sap cut off, and two inches thick, for it is better then, any other.

Then for the Captains Cabin or great Cabin, the Steerage, the half Deck, the Round-house, the Fore-castle, and to bind an end with the Capstern and all things fitting for the Sea, the Smiths work, the carving, joyning, and painting excepted, are the principal things I remembred to be observed: for a *Charter-party* betwixt the Merchant, the Master, and the Owner, you have Presidents of all sorts in most Scriveners shops.

CHAP. III.

How to proportion the Masts and Yards, for a Ship, by her Beam and Keel.

WHen a Ship is built, she should be masted, where in is a great deal of experience to be used so well as art; for if you **Over masse** her, either in length or bigness, she will lie too much down by a wind, and labour too much a hull, and that is called a **Taunt-mast**, but if either too small or too short, she is **Under-masted** or low-masted, and cannot bear so great a sail as should give her her true way. For a man of war, a well ordered Taunt-mast is best, but for a long voyage, a short-mast will bear more Canvas, and is less subject to bear by the board: Their Rules are divers, because no Artist can build a Ship so truly to proportion, neither set her Masts, but by the trial of her condition, they may be impaired or amended: suppose a Ship of 300 Tuns be 29 foot at the Beam, if her main mast be 24 inches diameter, the length of it must be 24 yards, for every inch in thickness is allowed a yard in length, and the fore-mast 22 inches in thickness, must be 22 yards in length; your Bowle-spret both in length and thickness must be equal to the fore-mast, the Misen 17 yards in length, and 17 inches diameter.

But the **Rule** most used is to take the $\frac{1}{3}$ parts of the breadth of the Ship, and multiply that by three, it will give you so many foot as your **Main-mast** should be in length, the bigness or thickness will bear it also, allowing an inch for a yard; but if it be a **Made-mast**, or **arme-mast**, that is greater than one Tree, it must be more; for example, suppose the Ships breadth 30 foot, four fifths of 30 foot are 24 foot, so you find the main Mast must be 24 yards long, for every yard is 3 foot 24 inches thorow, allowing an inch to every

A Ship over-masted.

Taunt-masted.
Under-masted.

An example.

The rule most used.

A made Mast,
or an arme
Mast.

every yard. The fore-Mast is to be in length $\frac{1}{4}$ of the main Mast, which will be 20 yards wanting one $\frac{1}{4}$ part of a yard, and 20 inches thorow. The Boulspret must ever be equal with the fore-Mast. The Misen-Mast half the length of the Main-Mast, which will be 12 yards long, and 12 inches diameter. Now as you take the proportion of the Mast from the Beam or breadth of the Ship, so do you the length of the yards from the Keel.

The Steps.
Partners.

These Masts have each their **Steps** in the Ship, and their **Partners** at every Dock where thorow they pass to the Keel, being strong Timbers bolted to the Beams in circling the Masts, to keep them steady in their steps fast wedged for rowing; yet some Ships will not sail so well as when it doth play a little, but that is very dangerous in foul weather.

Cotes.
Tarpawling.

Their **Cotes** are pieces of tarred Canvas, or a **Tarpawling** put about them and the Rudder to keep the water out. At

Checks.

the top of the fore Mast and main-Mast are spliced **Checks**, or thick clamps of wood, thorow which are in each two

The Hounds.

holes called the **Hounds**, wherein the Tyes do run to hoise the yards, but the Top-Mast hath but one hole or Hound, and one tye. Every Mast also hath a **Cap** if a top; which

The Cap.

is a piece of square Timber with a round hole in it to receive, the top Masts or Flag-Staffe, to keep them steady and strong, least they be born by the board in a stiffe-gale. The **Crosse-trees**

Crosse-trees.

are also at the head of the Masts, one let into another cross, and strongly bolted with the **Crossel-trees**, to keep up the top-Masts which are fastened in them, and those are at the tops of each Masts; all the Masts stand upright but the Boulspret which lyeth along over the Beak-head, and that Timber it resteth on is called the **Pillow**.

Pillow.

An example of
the Yards by
the Keel.

Now for the yards, suppose the Ship be 76 foot at the Keel, her main yard must be 21 yards in length, and in thickness but 17 inches. The fore-yard 19 yards long, and 15 inches diameter or thick. The spret-fail yard 16 yards long, and but 9 inches thick, and your Misen-yard so long as the Mast, the Top-yards bears half proportion to the main, and Fore-yard, and the Top-gallants, the half to them,

them, but this rule is not absolute, for if your Masts be taunt, your Yards must be the shorter; if a low Mast, the longer: but this is supposed the best, to have the main Yard $\frac{1}{2}$ parts of her Keel in length: the top-Yard $\frac{1}{4}$ of the main-Yard; and the main-Yard for bigness $\frac{1}{4}$ parts of an inch, for a yard in length. The length of the fore-Yard $\frac{1}{4}$ of the main Yard: the crossjack-Yard and Spret-fail Yard to be of a length, but you must allow the Misen-Yard and Spret-fail Yard $\frac{1}{4}$ inch of thickness to a yard in length. But to give a true Arithmetical and Geometrical proportion for the building of all sorts of Ships, were they all built after one mould, as also of their Masts, Yards, Cables, Cordage, and Sails, were all the stuff of like goodness, a methodical rule as you see might be projected; but their lengths, breadths, depths, rakes and burthens are so variable and different, that nothing but experience can possibly teach it.

CHAP. IV.

The names of all the Masts, Tops, and Yards belonging to a Ship.

THe Boulspret, the Spret-fail-Yard, the Spret-fail-Top-mast, the Spret-fail-Top fail-Yard, the fore-Mast, the fore-Yard, the fore-Top-mast, the fore-Top-fail-Yard, the fore-Top-gallant-Mast, the fore-Top-gallant-fail-Yard, Cotes, Wouddings, Gromits, and Staples for all Yards. The main Mast, the main-Yard, the main-Top. The main-Top-Mast, the main Top-fail-Yard. The Top-gallant Mast. The main Top-gallant-fail Yard. The *Truck* is a square piece of wood at the top, wherein you put the Flag-Staff. The Misen, the Misen-Yard, the Misen Top-mast, the Misen-Top-fail Yard: The Cross Jack. In great Ships they have two Mizens, the latter is called the Bonaventure Misen.

A Jury Mast, that is, when a Mast is born by the board, with Yards, Roofs, Trees, or what they can, spliced or fished together they make a Jury Mast, woulding or binding them with Ropes fast triced together with hand-spikes, as they use to would or bind any Mast or Yard.

CHAP. V.

How all the Tackling and Rigging of a Ship is made, fast one to another, with their names, and the reasons of their use.

Rigging or
Cordage.
A Mast well
rigged.
A Yard well
rigged.
Over-rigged.

All Masts have
Stays except
one.
A Coller.
A Lannier.

Dead mens
eyes.

Crows-feet.

THe Rigging a Ship, is all the Ropes or Cordage belonging to the Masts and Yards; and it is proper to say, The Mast is **well rigged**, or the Yard is **well rigged**, that is, when all the Ropes are well sised to a true proportion of her burthen. We say also, when they are too many or too great, she is **over-rigged**; and doth much wrong a Ship in her sailing; for a small weight aloft, is much more in that nature than a much greater below, and the more upright any Ship goeth, the better she saileth.

All the Masts, Top-Masts, and Flag-staves have Stays, excepting the Spret-sail Top-Mast; the main-Mast Stay is made fast by a **Lannier** to a **Coller**, which is a great Rope that comes about the Head and Boultspret, the other end to the head of the main-Mast. The main Top-Mast Stay is fastned to the head of the Fore mast by a strop and a **dead mans eye**. The main Top-gallant-Masts Stay in like mannor to the head of the Fore-Top-Mast. The fore Masts and stays belonging to them in like manner are fastned to the Boultspret, and Spret-sail Top-Mast, and those Stays do help to stay the Boultspret. The Misen stays do come to the main Mast, and the Misen Top-Mast Stays to the Shrowds with **Crows feet**: The use of those Stays are to keep the Masts from falling aftwards, or too much forwards. Those Lanniers are many small Ropes reeved into the dead mens eyes of all Shrowds,

Shrowds, either to slacken them or set them taut; also all the Stays have their blocks, and Dead mens eyes have Lanniers. Dead mens eyes are blocks, some small, some great, with many holes but no shivers; the Crows-feet reeved through them are a many of small lines, sometimes 6, 8, or 10, but of small use more than for fashion to make the Ship shew full of small Ropes. **Blocks** or **Pullies** are thick pieces of wood having **shivers** in them, which is a little wheel fixed in the midst with a **Cock** or **Pin**, some are brass, but the most of wood, whercon all the **running Ropes** do run, some are little, some great, with 3, 4, or 5 shivers in them, and are called by the names of the Ropes whereto they serve. There are also **double Blocks**, that where there is use of much strength will purchase with much ease, but not so fast as the other, and when we hale any Tackle or Halseyard to which two blocks do belong, when they meet, we call that **Block and Block**.

The **Shrowds** are great Ropes which go up either sides of all Masts. The Misen-main-Mast and fore-Mast Shrowds have at their lower ends Dead mens eyes seased into them, and are set up taut by Lanniers to the chains; at the other end, over the heads of those Masts are Pendants, for Tackles and Swiftners under them. The Top-Mast-Shrowds in like manner are fastned with Lanniers and Dead mens eyes to the Puttocks or Plats of iron belonging to them, aloft over the head of the Mast as the other: And the **Chains** are strong Plates of iron fast bolted into the Ships side by the Chain-wale. When the Shrowds are too stiff, we say, **ease them**, when too slack, we say, **set Taut the Shrowds**, but the Boultspret hath no Shrowds, and all those small Ropes that cross the Shrowds like steps are called **stallings**. The **Puttocks** go from the Shrowds of the fore-Mast, main-Mast or Misen, to go off from the Shrowds into the Top, Cap, or Bowl, which is a round thing at the head of either Mast for men to stand in, for when the Shrowds come near the top of the Mast, they fall in so much, that without the Puttocks you could not get into the Top, and in a manner they

Blocks or
Pullies.
Shivers.
A Cock.
Running ropes

Double Blocks.

Block and
Block.

All Masts have
Shrowds, &c.

Chains.

To ease.
Taut.
Rallings.
Puttocks.

they are a kind of a Shrowd. A Pendant is a short Rope made fast at one end to the head of the Mast or the Yards-arm, having at the other end a block with a shiver to receive some running rope in, as the Pendants of the back-stays and Tackles hang a little down on the inside of the Shrowds: all Yards-arms have them but the Mizen, into which the braces are reeved, and also there are Pendants or Streamers hang from the Yard-arms, made of Tassaty, or coloured Flanel-cloth to beautifie the Ship only: **Parrels** are little round Balls called Trucks, and little pieces of wood called **Ribs**, and ropes which do incircle the Masts, and so made fast to the Yards, that the Yards may slip up and down easily upon the Masts, and with the help of the **Brest-rope** doth keep the Yard close to the Mast. The **Standing-ropes** are the Shrowds and stays, because they are not removed, except it be to be eased or set tauter.

The **Tackles** or ropes run in three parts, having a Pendant with a block at the one end, and a block with a hook at the other, to heave any thing in or out of the Ship; they are of divers sorts, as the **Dores-tackles** made fast, the one to the fore Shrowds, the other to the main, to hoist the Boat in or out: Also the tackles that keep firm the Masts from straying. The **Gunnerys tackles** for haling in or out the Ordnance: but the **Winding tackle** is the greatest, which is a great double block with three shivers to the end of a small Cable about the head of the Mast, and serveeth as a Pendant; to which is made fast a **Guy**, which is a rope brought to it from the fore Mast, to keep the weight upon it steady, or from swinging to and again: Into the block is reeved a **Walfer**, which is also reeved thorow another double block, having a strop at the end of it, which put thorow the eye of the slings is locked into it with a fid, and so hoist the goods in or out by the help of the **Snap block**.

Cat harpings are small ropes run in little blocks from one side of the Ship to the other, neer the upper deck to keep the Shrowds tight for the more safety of the Masts from rowling. The **Walpyards** belong to all Masts, for by them we hoist

Parrels.

Ribs.

Brest-ropes.
Standing-ropes.The Tackles,
are of divers
sorts, &c.

Guy.

Walfer.

Snap-block.
Cat-harpings.

Walpyards.

hoist the Yards to their height, and the **Ties** are the ropes by which the Yards do hang, and do carry up the Yards when we strain the Halyards; the main-Yard and fore-Yard Ties are first reeved thorow the Rams-head, then thorow the Hounds, with a turn in the eye of the slings which are made fast to the Yard; the mizen-Yard and top-Yard have but single Ties, that is, one doth but run in one part, but the Spret-fail Yard hath none, for it is made fast with a pair of slings to the boltspret. A **Worse** is a rope made fast to the fore-mast Shrowds, and the Spret-fail sheats, to keep those sheats clear of the anchor-lookes.

To **Sling** is to make fast any Cask, Yard, Ordnance, or the like in a pair of **Slings**, and **Slings** are made of a rope spliced at either end into it self with one eye at either end, so long as to be sufficient to receive the Cask, the middle part of the rope also they seale together, and so maketh another eye to hitch the hook of the tackle, another sort are made much longer for the hoisting of Ordnance, another is a chain of iron to sling or bind the Yards fast aloft to the cross trees in a fight, lest the Tie should be cut, and so the Mast must fall. The **Canhooks** are two hooks fastened to the end of a rope with a noose, like that the Brewers use to sling or carry their barrels on, and those serve also to take in or out Hogheads or any other commodities. A **Parbunkel** is two ropes that have at each end a noose or lump that being crossed, you may set any vessel that hath but one head upon them, bringing but the loopes over the upper end of the Cask, fix but the tackle to them, and then the Vessel will stand straight in the midst to heave out, or take in without spilling.

Puddings are ropes nailed round to the Yards arms close to the end, a pretty distance one from another, to save the Robbins from galling upon the Yards, or to serve the anchors ring to save the clinch of the Cable from galling. And the **Robbins** are little lines reeved into the eyelet holes of the Sail under the Head-ropes, to make fast the Sail to the Yard, for in stead of tying, Sea-men always say, make fast. **Head lines**, are the ropes that make all the Sails fast to the Yard.

A Horse.

To Sling.
Slings.

Canlookes.

A Parbunkel.

Puddings.

Robbins.

Head lines.

Larling

- Furling-lines.** **Furling-lines** are small lines made fast to the Top-sail, Top-gallant-sail, and the Miffen-yards arms. The Miffen hath but one called the **Smiting line**, the other on each side one, and by these we farthel or bind up the Sails. The
- Brals.** **Brals** are small ropes reeved through blocks seased on each side the ties, and come down before the Sail, and at the very skirt are fastened to the Creengles, with them we furl or farthel our Sails a cross, and they belong only to the two Courses and the Miffen: to hale up the Brals, or brale up the Sail, is all one: **Creengles** are little ropes spliced into the Boltropes of all Sails belonging to the Main and Fore-mast, to which the Bolings-bridles are made fast, and to hold by when we shake off a Bonnet.
- Bolt-ropes:** **Boltropes** is that rope is sewed about every Sail, soft and gently twisted, for the better sewing and handling the Sails. **Bunt lines** is but a small rope made fast to the midft of the Boltrope to a Crengle reeved through a small Block which is seased to the Yard, to trice or draw up the bunt of the Sail, when you farthel or make it up. The **Clew-garnet** is a rope made fast to the Clew of the Sail, and from thence runs in a block seased to the middle of the Yard, which in Furling doth hale up the Clew of the Sail close to the middle of the Yard, and the **Clew-line** is the same to the Top-sails, top-gallant, and Spret-sails, as the Clew-garnet is to the Main and Fore-sails. The **Clew** of a Sail is the lower corner next the Sheet and Tackles, and stretcheth somewhat goaring or sloping from the square of the Sail, and according to the **Goaring** the is said to spread a great or a little Clew. **Tackles** are great ropes which having a wall-knot at one end seased into the Clew of the Sail and so reeved first through the Chestres, and then cometh in at a hole in the Ships sides, this doth carry forward the clew of the Sail to make it stand close by a wind. The **Sheats** are bent to the Clews of all Sails, in the low-sails they hale aft the Clew of the Sails, but in Top-sails they serve to hale them home, that is, to bring the Clew close to the Yards-arm. The **Braces** belong to all yards but the Miffen, every yard hath

- hath two reeved at their ends thorough two pendants, and those are to square the yards, or traverse them as you please. The **Boling** is made fast to the leech of the Sail about the midft to make it stand the sharper or closer by a winde, it is fastened by two, three, or four Ropes like a Crows foot to as many parts of the Sail which is called the **Boling-bridles**, only the Miffen-boling is fastened to the lower end of the Yard, this Rope belongs to all Sails except the Spret-sail, and Spret-sail Top-sail, which not having any place to hale it forward by, they cannot use those Sails by a wind: **Sharp the main Boling**, is to hale it taut: **Hale up the Boling**, is to pull it harder forward on: **check or ease the Boling** is to let it be more slack.
- Lee-fannings** is a Rope reeved into the Creengles of the courses, when we would hale in the bottom of the Sail, to lash on a bonnet, or take in the Sail; and **Reeving** is but drawing a Rope through a block or oylet to run up and down **Leech-lines** are small Ropes made fast to the Leech of the top-sails, for they belong to no other; and are reeved into a block at the Yard close by the Top-sail ties, to hale in the Leech of the Sail when you take them in. The **Leech of a Sail** is the outward side of a skirt of a Sail, from the earing to the clew; and the **Earing** is that part of the Bunt-rope which at all the four corners of the Sail is left open as it were a ring. The two upmost parts are put over the ends of the Yards-arms, and so made fast to the Yards, and the lowermost are seased or bent to the Sheats, and tacks into the clew. The **Lifts** are two Ropes which belong to all Yards-arms, to top the Yards; that is, to make them hang higher or lower at your pleasure. But the top-sail **Lifts** do serve for Sheats to the Top-gallant-Yards, the haling them is called the topping the Lifts, as Top-a-starboard, or Top-a-port.
- Legs** are small Ropes put through the Bolt-ropes of the main and fore-sail, near to a foot in length, spliced each end into the other in the Leech of the Sail, having a little eye whereunto the Martnets are fastened by two hitches, and the end seased into the standing parts of the **Martnets**, which are

Boling.

Boling-bridles.

Sharp the Bo-
ling.
Hale the
Boling.
Check the
Boling.
Lee fannings.

Reeving.
Leech-lines.

Leech of a
sail.

Earrings:

Bent.
Lifts.

Topping the
Lifts.

Legs:

Martnet.

Latches.

Lashing.

The Loofe-hook.

Chesters.
House.A Bonner.
A Drabler.
A Course.

A Knave-line.

Knetrels.

Rope-yarnes.

Sinner.

Mats or Panch.

are also small lines like Crow-feet reeved through a block at the Top mast-head, and so comes down by the Mast to the Deck; but the Top-sail Martnets are made fast to the head of the Top-gallant-mast, and cometh but to the top, where it is haled and called the Top-martnets, they serve to bring that part of the Leech next the Yards-arm up close to the Yard.

Latches are small lines sowed in the Bonnets and Drablers like loops to lash or make fast the Bonnet to the course, or the course to the Drabler, which we call **lashing** the Bonnet to the course, or the Drabler to the Bonnet. The **Loofe-hook** is a tackle with two hooks, one to hitch into a chingle of the main, or fore-Sail, in the Bolt-rope in the Leech of the Sail by the clew, and the other to strap spliced to the **Chesters** to **House** or pull down the Sail to succour the tacks in a stiff-gale of wind, or take off or put on a **Bonner** or a **Drabler**, which are two short sails to take off or put to the fore-Course or the main, which is the fore Sail, or main-Sail.

The **Knave-line** is a Rope hath one end fastened to the cross-trees, and so comes down by the ties to the Rams-head, to which is seased a small piece of wood some two foot long with a hole in the end, whereunto the line is reeved, and brought to the Ships side, and haled taut to the Railes to keep the ties and Halyards from turning about one another when they are new. **Knetrels** are two Rope-yarnes twisted together, and a knot at each end, whereunto to sease a block, a rope, or the like. **Rope-yarnes** are the Yarnes of any rope untwisted, they serve to sarve small ropes, or make **Sinner**, **Mats**, **Plats**, or **Caburns**, and make up the Sails at the Yards-arms.

Sinner is a string made of Rope-yarn commonly of two, four, six, eight or nine strings platted in three parts, which being beat flat they use it to sarve ropes or **Mats**. That which we call a **Panch**, are broad clouts, woven of Thrums and Sinner together, to save things from galling about the main and fore-Yards at the Ties, and also from the Masts, and upon the Boltspret, Loufe, Beake head or Gunwaile, to save the clewes of the Sails from galling or fretting.

Caburn

Caburne is a small line made of Spun-yarn to make a bend of two Cables, or to sease the Tackels, or the like. **Seasing** is to bind fast any ropes together, with some small rope-yarne.

Marline is any line, to a block, or any Tackle, Pendant, Garnet, or the like. There is also a rope by which the Boat doth ride by the Ships side, which we call a **Seafen**. To **sarve** any rope with Plats or Sinner, is but to lay Sinner, Spun-yarn, Rope-yarn, or a piece of Canvas upon the rope, and then rowl it fast to keep the rope from galling about the Shrowds at the head of the Masts, the Cable in the Hawse, the flook of the Anchor, the Boat-rope or any thing. **Spun-yarn** is nothing but rope-yarn made small at the ends, and so spun one to another so long as you will with a winch. Also **Caskets** are but small ropes of Sinner made fast to the gromits or rings upon the Yards, the longest are in the midst of the Yards betwixt the Ties, and are called the brest-Caskets, hanging on each side the Yard in small lengths only to bind up the Sail when it is furled.

Marling is a small line of untwisted hemp, very pliant and well tarred, to sease the ends of Ropes from raveling out, or the sides of the blocks at their arses, or if the Sail rent out of the Boltrope, they will make it fast with Marlin till they have leisure to mend it. The **Marling spike**, is but a small piece of Iron to splice ropes together, or open the Bolt-rope when you sew the sail. **Splicing** is so to let one ropes end into another, they shall be as firm as if they were but one rope, and this is called a **round Splice**; but the **cut Splice** is to let one into another with as much distance as you will, and yet be strong, and undo when you will. Now to make an end of this discourse with a **knot**, you are to know, Seamen use three, the first is called the **Wall-knot**, which is a round knob, so made with the strouds or layes of a rope, it cannot slip; the Sheets, Tackes, and Stoppers use this knot. The **Bolting-knot** is also so firmly made and fastened by the bridles into the creengles of the Sails, they will break, or the Sail split before it will slip. The last is the **Sheepshank** which is a knot they cast them upon a runner or Tackle when

Caburne.
Seasing.Seafen.
Serve or
Sirvis.

Spun-yarn.

Caskets.

Marling.

Marling-spike.

Splicing.

A round Splice.
A cut Splice.A Knot.
A Wall-Knot.

A Bolting-knot.

Sheepshank-
Knot.

it is too long to take in the goods, and by this knot they can shorten a Rope without cutting it, as much as they list, and presently undo it again, and yet never the worse.

CHAP. VI.

What doth belong to the Boats and Skiffe, with the definition of all those Thirteen Ropes which are only properly called Ropes belonging to a Ship and the Boat, and their use.

A Long-Boat.

OF Boats there are divers sorts, but those belonging to Ships, are called either the **Long Boat**, or Ships Boat, which should be able to weigh her Sheet Anchor, those will live in any reasonable Sea, especially the Long-Boat: Great Ships have also other small Boats called **Shallops** and **Skiffs**, which are with more ease and less trouble rowed to and again upon any small occasion. To a Boat belongs a Mast and Sail, a Stay-sheet and Halyard, Rudder, and Rudder-Irons, as to a Ship, also in any Discovery they use a **Tarpawling**, which is a good piece of Canvas washed over with Tar, to cover the **Bailes** or Hoopes over the Stern of their Boat, where they lodg in an Harbour, which is that you call a Tilt covered with Wadmall in your Wherries; or else an **Awning**, which is but the Boats-sail, or some piece of an old Sail brought over the Yard and Stay, and boomed out with the Boat-hook, so spread over their heads, which is also much used, as well a shore as in a Ship, especially in hot Countries to keep men from the extremity of heat or wet, which is very oft infectious. **Thoughts** are the Seats whereon the Rowers sit; and **Chowies** small Pines put into little holes in the Gunwails or upon the Boats-side, against which they bear the Oars when they row, they have also a **David**; and also in Long-Boats

A Shallop.

A Skiff.

Tarpawling.
Bailes.

Awning.

Thoughts.
Chowies.

boats a windless to weigh the Anchor by, which is with more ease than the Ship can. The two arching timbers against the boat-head are called **Carlings**. Man the boat is to put a **Gang** of men, which is a company into her, they are commonly called the **Coxswains Gang**, who hath the charge of her. **Free the Boat** is to bail or cast out the water. **Trim the Boat** is to keep her straight. **Wind the Boat** is to bring her head the other way. **Hold water** is to stay her. **Forbear** is to hold still any Oar you are commanded, either on the broad, or whole side. A fresh **Spell** is to relieve the Rowers with another Gang. Give the Boat more way for a dram of the Bortell, who lays Amends, one and all, **Wea, wea, wea, wea, wea**, that is, they pull all strongly together.

The **Entering rope** is tyed by the Ships side, to hold by as you go up the entering Ladder, cleats, or wailles.

The **Bucket-rope** that is tied to the Bucket by which you hale and draw water up by the Ships side.

The **Bolt-ropes** are those wherein the Sails are fowed.

The **Port-ropes** hale up the Ports of the Ordnance.

The **Jeare-rope** is a piece of a Hawser made fast to the Main-yard, another to the Fore-yard close to the Ties, reeved through a Block which is seafed close to the top, and so comes down by the Mast, and is reeved through another Block at the bottom of the Mast close by the Deck; great Ships have on each side the Ties one, but small Ships none: the use is to help to hoise up the Yard to succour the Ties, which though they break yet they would hold up the Mast.

The **Preventer rope** is a little one seafed cross over the Ties, that if one part of them should break, yet the other should not run through the Rams head to indanger the Yard.

The **Top-ropes** are those wherewith we set or strike the main or fore top masts, it is reeved through a great Block seafed under the Cap, reeved through the heel of the Top-mast thwart Ships, and then made fast to a ring with a clinch on the other side the Cap, the other part comes down

A Gang.

Free or Bail.

Trim Boar.

Wind Boar.

Hold water.

Forbear.

A Spell.

Vea, vea, vea.

The Entering-rope.

Bucket-rope.

Bolt-ropes.

Port-ropes.

Jeare-rope.

Preventer-rope.

Top-rope.

by the Ties, reeved into the Knights, and so brought to the Capstain when they set the Top-masts.

Keel-ropes. The **Keel rope**, you have read in the building, is of hair in the Keel to scower the Limber-holes.

Rudder-rope. The **Rudder-rope** is reeved through the Stem-post, and goeth through the head of the Rudder, and then both ends Spliced together, serves to save the Rudder if it should be struck off the Irons.

Cat-rope. The **Cat-rope** is to hale up the Cat.

Boy-rope. The **Boy rope** is that which is tied to the Boy by the one end, and the Anchors flook by the other.

Boat-rope. The **Boat-rope** is that which the Ship doth tow her Boat by, at her Stern.

Chest-rope. The **Chest rope** is added to the Boat-rope when she is towed at the Ships stern, to keep her from **sheaving**, that is, from swinging to and again; for in a stiff gale she will make such yaws, and have such girds, it would indanger her to be torn in pieces, but that they use to **swift** her, that is, to incircle the Gunwale with a good rope, and to that make fast the **Chest rope**.

Swifting.

C H A P.

C H A P. VII.

The Names of all sorts of Anchors, Cables, and Sails; and how they bear their proportions, with their use; Also how the Ordnance should be placed, and the Goods stowed in a Ship.

THE proper terms belonging to **Anchors** are many: the least are called **Kedgers**, to use in calm weather in a slow stream, or to kedge up and down a narrow River, which is when they fear the wind or tide may drive them on shore; they row by her with an Anchor in a Boat, and in the midst of the stream, or where they find most fit if the Ship come too near the shore, and so by a Hawser wind her head about; then weigh it again till the like occasion, and this is **Kedging**. There is also a **Stream-Anchor**, not much bigger, to stem an easie stream or tide. Then there is the **first**, **second**, and **third Anchor**, yet all such as a Ship in fair weather may ride by, and are called **Bow-Anchors**. The greatest is the **Sheet-Anchor**, and never used but in great necessity. They are commonly made according to the Burthen of the Ship by proportion, for that the **Sheet-Anchor** of a small Ship will not serve for a **Kedger** to a great Ship. Also it beareth a proportion in it self, as the one flook, which is that doth stick in the ground, is but the third part of the **Shank** in length; at the head of the shank there is a hole called an **Eye**, and in it a **Ring**, where in is the **Put** to which there is fast fixed a **Stock** of wood crossing the **Flocks**, and the length is taken from the length of the Shank. These differ not in shape but in weight, from two hundred, to three or four thousand weight. **Chapels** or **Grapples**, are the least of all, and have four Flocks but

A. Kedger.

Stream-Anchor.
The first,
Second,
Third Anchor.
Sheet-Anchor.

An Anchors
Shank.
Flook.
Shoulder.
Beam or Nag.
Eye.
Put.
Stock.

Grapple.

but no stock; for a Boat to ride by, or to throw into a Ship in a fight, to pull down the gratings or hold fast,

The **Cables** also carry a proportion to the Anchors, but if it be not three stroud, it is accounted but a Hawser, yet a great Ships Hawser may be a Cable to the Sheet-anchor for a small Ship: and there is the first, second, and third Cable, besides the **Sheet-Anchor Cable**. If the Cable be well made, we say it is well laid. To **Reckell** or sarve the Cable, as is said, is but to bind some old clouts to keep it from galling in the Hawse or Ring. **Splice** a Cable, is to fasten two ends together, that it may be double in length, to make the Ship ride with more ease, and is called a **shot of Cable**. **Quoile** a Cable, is to lay it up in a round Ring, or false one above another. **Pay more Cable**, is when you carry an Anchor out in the Boat to turn over. **Pay cheap**, is when you over set it, or turns it over-board faster. **Veere more Cable**, is when you ride at Anchor. And **end for end** is when the Cable runneth clear out of the Hawse, or any rope out of his shiver. A **Bight** is to hold by any part of a coile, that is, the upmost fake. A **Bitter** is but the turn of a Cable about the Bits, and veere it out by little and little. And the **Bitters end** is that part of the Cable doth stay within board. **Gert**, is when the Cable is so taut that upon the turning of a tide, a Ship cannot go over it.

To **bend the Cable** to the Anchor, is to make it fast to the Ring; **unbend the Cable**, is but to take it away, which we usually do when we are at Sea, and to tie two ropes or Cables together is called **bending**. **Hitch**, is to catch hold of any thing with a rope to hold it fast, or with a hook, as hitch the Fish-hook to the Anchors flook, or the Tackles into the Garnets of the Slings. **Fenders** are pieces of old **l-ausers** called **Junkies** hung over the Ship-sides to keep them from bruising. In Boats they use Poles or Boat-hooks to fend off the Boat from bruising. A **Brest fast** is a rope which is fastened to some part of the Ship forward on, to hold her head to a Wharff or any thing, and a **Stern fast** is the same in the Stern. The use for the Hawser is to

warp

A Cable, the first, second, and third.

Sheet-Anchor Cable.
Reckell.

Splice.

A shot of Cable.
Quoile.
A Fake.
Pay more Cable.
Pay cheap.
Veere more Cable.
End for end.
A Bight.

A Bitter.
A Bitters end.
Gert.

To bend
Unbend.

Pending.
Hitch.

Fenders.
Junkies.

Brest-fast.

Stern-fast.

warp the Ship by, which is laying out an Anchor, and wind her up to it by a Capstern. **Roufing** is but pulling the slackness of any Cables with mens hands into the Ship. The **Shank-panter** is a short chain fastened under the Fore-masts throwls with a bolt to the Ships sides, and at the other end a rope to make fast the Anchor to the Bowe. To **Stop** is when you come to an Anchor, and veeres out your Cable, but by degrees till the Ship ride well, then they say stop the Ship. To those Cables and Anchors belong short pieces of wood called **Boys**, or close hooped Barrels like Tankards as is said, but much shorter, to shew you the Anchor and help to weigh it, there is another sort of Cans called **Can Boys** much greater, moored upon shoules to give Mariners warning of the dangers.

The **Main-sail** and the **Fore sail** is called the **Fore-course**, and the **main course**, or a pair of Courses. **Bonnet** and **Drablers** are commonly one third part a piece to the Sail they belong unto in depth, but their proportion is uncertain; for some will make the main-Sail so deep, that with a shallow **Bonnet** they will cloath all the Mast without a **Drabler**, but without Bonnets we call them but Courses; we say, lash on the Bonnet to the Course, because it is made fast with Latchets into the Eylot-holes of the Sail, as the Drabler is to it, and used as the wind permits. There is also your **Main-top sail**, and **Fore-top-sail**, with their **Top-gallant sails**, and in a fair Gale your **Studding-sails**, which are Bolts of Canvas, or any cloth that will hold wind, we extend alongst the side of the Main sail, and Booms it out with a Boom or long Pole, which we use also sometimes to the Clow of the Main-sail, Fore-sail, and Spret-sail, when you go before the Wind or Quartering, else not. Your **Misen**, and **Misen-top-sail**, your Spret and **Spret-top-sail**, as the rest, take all their names of their Yards. A **Drift-sail** is only used under water, veered out right a head by Sheets, to keep the Ships-head right upon the Sea in a storm, or when a Ship drives too fast in a current. A **Netting sail** is only a Sail laid over the **Netting**, which is small Ropes from the top of the

Roufing.

Shank-panter.

Stop.

Boyes.

Can-Boyes.

Sailes.
Main-Sail.
Fore-Sail.
Main-course.
Fore-course.
Bonnets.
Drablers.

Main-top-sail.
Fore-top-sail.
Top-gallant-Sails.
Studding-sails.

Misen.
Misen-top-sail.
Spret-sail.
Spret-fail-top.
Sail.
Drift-sail.

Netting-sail.
Nettings.

Waist-trees.
Rouse-trees.

Stantions.
Gratings.

Head-Sails.

After-Sails.

Leech.

The Clew.

Goring.

A Monk-seam.
A Round-seam.

A Tier.
Third.
Second.

the Fore-castle to the Poop, stretched upon the Ledges from the **Waist-trees** to the **House trees**, which are only small Timbers to bear up the **Gratings** from the half-Deck to the Fore-castle, supported by **Stantions** that rest upon the half-Deck; and this Netting or **Grating**, which is but the like made of Wood, you may set up or take down when you please, and is called the close Fights fore and aft. Now the use of those Sails is thus, all **Head-sails**, which are those belonging to the Fore-mast and Bolt-sprit, do keep the Ship from the Wind or to fall off: All **After-sails**, that is, all the Sails belonging to the Main-mast and Mizen, keeps her to Wind-ward, therefore few Ships will steer upon Quarter-winds with one Sail, but must have one after Sail, and one Head-sail. The Sails are cut in proportion as the Masts and Yards are in breadth and length, but the Sprit-sail is $\frac{3}{4}$ parts the depth of the Fore-sail, and the Mizen by the Leech twice so deep as the Mast is long from the Deck to the Hounds. The **Leech** of a Sail is the outward side or skirt of the Sail from the Earing to the Clew, the middle betwixt which we account the Leech. The **Clew**, is the lower corner of a Sail, to which you make fast your Sheets and Tacks, or that which comes goring out from the square of the Sail, for a Square-sail hath no Clew, but the Main-sail must be cut **Goring**, because the Tacks will come closer aboard, and so cause the Sail to hold more wind; now when the Sail is large and hath a good Clew, we say she spreads a large Clew, or spreads much Canvas. In making those Sails they use two sorts of Seams down the Sails, which doth sew the breadth of the Canvas together, the one we call a **Monk seam**, which is flat, the other a **Round seam**, which is so called because it is round.

The Ship being thus provided, there wants yet her **Ordnance**, which should be in greatness according to her building in strength and burthen, but the greatest commonly lieth lowest, which we call the lower **Tier**, if she be furnished fore and aft. Likewise the second Tier, and the third, which are the smallest. The Fore-castle and the half-

half Deck being also furnished, we account half a Half a Tier.

Stowage or to Stow, is to put the goods in Howl in order. The most ponderous next the Ballast, which is next the Keelson to keep her stiffe in the Sea. **Ballast** is either Gravel, Stones, or Lead, but that which is driest, heaviest, and lies closest is best. To find a leak, they **Crench the Ballast**, that is, to divide it. The Ballast will sometimes **Shoot**, that is, run from one side to another, and so will Corn and Salt, if you make not Pouches or Bulk-heads, which when the Ship doth heeld is very dangerous to overset or turn the Keel upwards. For Cask that is so stowed, Tier above Tier with Ballast, and **Canting-Coines**, which are little short peices of wood or Billets cut with a sharp ridge or edge to lie betwixt the Cask; and **Standing-Coines** are Billets or Pipe-staves, to make them they cannot give way nor stir. The Ship will **bear much**, that is, carry much Ordnance or goods, or bear much Sail; and when you let any thing down into the Howl, lowering it by degrees, they say, **Amain**; and being down, **Strike**.

Stowage.
To Stow.
Ballast.

Trench the
Ballast.
Shoot.

Canting-
Coines.

Standing-
Coines.
To bear.

Amain.
Strike.

F

CHAP.

CHAP. VIII.

The Charge and Duty of the Captain of a Ship, and every Office and Officer in a Man of War.

The Captains Charge.

THE Captains Charge is to command all, and tell the Master to what Port he will go, or to what Height. In a Fight, he is to give Direction for the managing thereof, and the Master is to see the cunning of the Ship, and Trimming of the Sails.

The Master and his Mates.

The **Master** and his **Mates** are to direct the course, command all the Sailors, for Steering, Trimming, and Sailing the Ship; his Mates are only hid Seconds, allowed sometimes for the two Mid-Ships Men, that ought to take charge of the first prize.

The Pilot.

The **Pilot** when they make Land doth take the charge of the Ship till he bring her to Harbour.

The Chirurgion and his Mate.

The **Chirurgion** is to be exempted from all duty, but to attend the Sick, and cure the wounded: and good care would be had he have a Certificate from Barber-Chirurgions Hall of his sufficiency, and also that his Chest be well furnished both for Physick and Chirurgery, and so near as may be proper for that clime you go for, which neglect hath been the loss of many a mans Life.

The Cap-Merchant or Purser.

The **Cap Merchant** or **Purser** hath the charge of all the Carragafoun or Merchandize, and doth keep an account of all that is received, or delivered, but a Man of War hath only a Purser.

The Gunner with his Mate, and quarter Gunners.

The Master **Gunner** hath the Charge of the *Ordnance*, and *Shot*, *Powder*, *Match*, *Ladles*, *Sprunges*, *Worms*, *Cavtrages*, *Arms* and *Fire-Works*; and the rest of the **Gunners**, or **Quarter Gunners** to receive their Charge from him according to directions, and to give an account of their stores.

The Carpenter and his Mate.

The **Carpenter** and his **Mate**, is to have the *Nails*, *Chisels*, *Roove* and *Clinch-nails*, *Pikes*, *Splates*, *Rudder-Irons*, *Pump-*

Pump nails, *Skupper nails*, and *Leather*, *Sawes*, *files*, *Hatchets*, and such like, and ever ready for calking, Breaming, Stopping leaks, Fishing, or splicing the Masts or Yards as occasion requireth, and to give account of his Store.

The **Boatswain** is to have the Charge of all the *Cordage*, *Tackling*, *Sails*, *Fids* and *Marling-spikes*, *Needles*, *Twine*, *Sail-cloth*, and *Rigging* the Ship, his **Mate** the Command of the *Long Boat*, for the setting forth of *Anchors*, weighing or fetching home an *Ancher*, *Warping*, *Towing*, or *Moring*, and to give an account of his Store.

The Boatswain and his Mate.

The **Trumpeter** is always to attend the Captains Command, and to sound either at his going a Shore, or coming aboard, at the entertainment of Strangers, also when you hale a Ship, when you charge, board, or enter; and the Poop is his place to stand or sit upon, if there be a noise, they are to attend him, if there be not, every one he doth teach to bear a part, the Captain is to encourage him, by increasing his Shares, or pay, and give the Master Trumpeter a reward.

The Trumpeter.

The **Marshal** is to punish Offenders, and to see Justice executed according to Directions; *As Ducking at the Yards Arm*, *haling under the Keel*, *bound to the Capstern*, or *main-Mast with a Basket of Shot about his Neck*, *setting in the Bilboes*, and to pay the *Cobty* or the *Morjoun*; but the Boys the Boatswain is to see every Munday at the Chest, to lay their compass, and receive their punishment for all their Weeks offences, which done, they are to have a quarter Can of Beer, and a Bisket of Bread, but if the Boatswain Eat or Drink before he catch them, they are free.

The Marshal.

The **Corporal** is to see the *Setting* and *Relieving the Watch*, and see all the Souldiers and Sailors keep their arms clean, Neat, and Yare, and teach them their use.

The Corporal.

The **Steward** is to deliver out the *Vittuals* according to the Captains directions, and Meas them four, five, or six, as there is occasion.

The Steward and his Mate.

The **Quarter-Masters** have the Charge of the *Howle*, for *Stowing*, *Romaging* and *Trimming* the Ship in the hold,

The Quarter-Master.

and of their Squadrons for the Watch, and for Fishing to have a *Sayne*, a *Fisgig*, a *Harpin-yron*, and *Fishhooks*, for *Porgos*, *Bonetos*, *Dolphins*, or *Dorados*, and *Rayling-lines* for *Mackrels*.

The Cooper
and his Mate.

The **Cooper** is to look to the *Cask*, *Hoops* and *Twigs*, to *Stave* or *repair* the *Buckets*, *Baricos*, *Cans*, *Steep-tubs*, *Rumlets*, *Hogheads*, *Pipes*, *Buts*, &c. For *Wine*, *Bear*, *Sider*, *Beverage*, *Fresh-water*, or any *Liquor*.

The Coxswain
and his Mate.

The **Coxswain** is to have a choice *Gang* to attend the *Skiffe*, to go to and again as occasion commandeth.

The Cook and
his Mate.

The **Cook** is to dress and deliver out the *Viſtual*, he hath his *Store* of *Quarter Cans*, *small Cans*, *Platters*, *Spoons*, *Lanthornes*, &c. And is to give his *Account* of the remainder.

The Swabber.

The **Swabber** is to wash and keep clean the Ship and *Maps*.

The Liar.

The **Liar** is to hold his place but for a week, and he that is first taken with a lie, every Monday is so proclaimed at the main-Mast by a general cry, *a Liar, a Liar, a Liar*, he is under the Swabber, and only to keep clean the *Beak-head*, and *Chains*.

The Sailers.

The **Sailers** are the ancient men for hoisting the *Sails*, getting the *tacks* aboard, *haling* the *Bowling*, and *Steering* the Ship.

The Youngers

The **Youngers** are the young men called *fore Mast-men*, to take in the top *sails*, or *Top and Yard*, for *furling* the *Sails*, or *Slings* the *Yards*, *Bousing* or *Trising*, and take their turns at *Helm*.

The Lieutenant,
his plaze.

The **Lieutenant** is to associate the *Captain*, and in his absence to execute his place, he is to see the *Marshal* and *Corporal* do their duties, and assist them in instructing the *Souldiers*, and in a fight the *fore-castle* is his place to make good, as the *Captain* doth the *Half-deck*, and the *Quarter-Masters*, or *Masters-Mate*, the *Mid-ships*, and in a *States-man of War*, he is allowed as necessary as a *Lieutenant* on *Shore*.

CHAP. IX.

Proper Sea-terms for dividing the Company at Sea, and steering, sailing, or moving a Ship in fair weather, or in a storm.

IT is to be supposed by this the Ship is victualled and manned, the Voyage determined, the *steep-Tubs* in the *Chains* to shift their *Beef*, *Pork*, or *Fish* in salt water, till the salt be out, though not the saltness, and all things else ready to set sail; but before we go any further, for the better understanding thereof, a few words for *steering* and *cunning* the Ship would not be amiss. Then know, *Star-board* is the right hand, *Larboard* the left; *Starboard* the *Helm*, is to put the *Helm* a *Starboard*, then the Ship will go to the *Larboard*. *Right your Helm*, that is, to keep it in the *mid-Ships*, or *right up*. *Port*, that is, to put the *Helm* to *Larboard*, and the Ship will go to the *Starboard*, for the Ship will ever go contrary to the *Helm*. Now by a quarter wind, they will say *aloof*, or *keep your Tow*, keep her to it, have a care of your *Lee-latch*. Touch the wind, and *war no more*, is no more but to bid him at the *Helm* to keep her so near the wind as may be; *no near*, ease the *Helm*, or *bear up*, is to let her fall to *Lee ward*. *Steady*, that is, to keep her right upon that point you steer by; *be pare* at the *Helm*, or a fresh man to the *Helm*. But he that keeps the Ship most from yawing, doth commonly use the least motion with the *Helm*, and those steer the best.

The Master and Company being aboard, he commands them to get the *Sails* to the *Yards*, and about your *gear*, or work on all hands, stretch forward your main *Hallyards*, hoise your *Sails* half *Mast* high. *Prepy*, or make ready to set sail, cross your *Yards*, bring your *Cable* to the *Capstern*; *Boatwain* fetch an *Anchor* aboard, break ground or weigh *Anchor*. Heave a head, men into the *Tops*, men upon the *Yards*; come, is the *Anchor*, a *pile*, that is, to heave the

Steep-Tubs:

Steering,
Cunning,
Starboard,
Larboard.

Mid ships.
Port.

Aloof.
Keep your
loof.
War no more.
No near.
Ease.
Steady.
Yare.

Gear.

Prepy.

A File.

Hawse

Tally.

Hawse of the ship right over the Anchor: what is the Anchor away? Yea, yea. Let fall your Fore-sail. **Tally**, that is, hale off the Sheats; who is at the Helm there? coil your Cables in small fakes, hale the Cat, a Bitter, belay, loose fast your Anchor with your Shank-painter, stow the Boat, set the land, how it bears by the Compass, that we may the better know thereby to keep our account, and direct our course, let fall your Main sail, every man say his private Prayer for a boon Voyage, out with your spret-sail, on with your Bonnets and Drablers, steer steady and keep your course, so, you go well.

*How they divide the Company at Sea, and set,
and rule the Watch.*

WHEN this is done, the Captain or Master commands the Boatswain to call up the Company; the Master being chief of the Starboard-watch, doth call one, and his right hand Mate on the Larboard doth call another, and so forward till they be divided into two parts, then each man is to chuse his Mate, Consort, or Comrade, and then divide them into squadrons according to your number and burthen of your Ship, as you see occasion; these are to take their turns at the Helm, trim sails, pump, and do all duties each half, or each squadron for eight Glasses, or four hours, which is a Watch; but care would be had, that there be not two Comrades upon one Watch, because they may have the more room in their Cabbins to rest. And as the Captain and Master's Mates, Gunners, Carpenters, Quartermasters, Trumpeters, &c. are to be abaft the Mast, so the Boatswain, and all the Yonkers or common Sailers under his command is to be before the Mast. The next is, to mess them four to a Mess, and then give every Mess a quarter Can of Beer, and a Bisket of Bread to stay their stomachs till the Kettle be boiled, that they may first go to Prayer, then to supper, and at six a Clock sing a Psalm, say a Prayer, and the Master with his side begins the Watch, then all the rest may do what

what they will till midnight; and then his Mate with his Larboard men, with a Psalm and a Prayer, relieves them till four in the Morning, and so from eight to twelve each other, except some flaw of wind come, some storm, or gulf, or some accident that requires the help of all hands which commonly after such good Cheer in most Voyages doth happen.

For now the **wind veers**, that is, it doth shift from point to point, get your Starboard-tackles aboard, and **tally** or hale off your Lee sheets. The Ship will not wayer, settle your main Top-sail, veere a sadome of your sheet. The wind comes fair again and a fresh gale, hale up the Slatch of the Lee-boling. By Slatch is meant the middle part of any Rope hangs over-board. Veere more sheet, or a **flown** sheet, that is, when they are not haled home to the Block. But when we say, let **fly** the sheets, then they let go amain, which commonly is in some gulf, lest they spend their Top-sails, or if her quick side lie in the water, over-set the Ship. A Flown-sheet is when she goes before the wind, or betwixt a **pair of sheets**, or all Sails drawing. But the wind shrinks, that is, when you must take in the Spret-sail, and get the Tacks aboard, hale close the main Boling, that is, when your Tacks are close aboard. If you would sail against the wind, or keep your own, that is, not to fall to Lee-ward, or go back again, by haling off close your Bolings, you set your Sails so sharp as you can to lie close by a wind, thwarting it a League or two, or more or less, as you see cause, first on the one board, then on the other; this we call boarding or beating it up upon a Tack in the winds eye, or bolting to and again; but the longer your Boards are, the more you work or gather into the wind. If a sudden flaw of wind should surprize you, when you would lower a Yard so fast as you can, they call *Amain*; but a cross sail cannot come nearer the wind than six points, but a Carvel, whose Sails stands like a pair of Tailors sheers, will go much nearer.

The wind
veers.
Tally.

Flown.

Fly.

A pair of cour-
ses.

How

How to handle a Ship in a Storm.

T Overcasts, we shall have wind, foul weather, settle your Top-sails, take in the Spret-sail, in with your Top-sails, lower the Fore-sail, tallow under the Parrels, brade up close all them Sails, lash sure the Ordnance, strike your Top-masts to the Cap, make it sure with your Sheeps-feet. A storm, let us lie at **Trie** with our main Course, that is, to hale the Tack aboard, the Sheet close aft, the Boling set up, and the Helm tied close aboard. When that will not serve, then try the Misen, if that split, or the storm grow so great that she cannot bear it, then **hull**, which is to bear no fail, but to strike a hull is when they would lie obscurely in the Sea, or stay for some Comfort, lash sure the Helm a lee, and so a good Ship will lie at ease **under the Sea**, as we term it. If she will **weather coil**, and lay her head the other way without loosing a sail, that must be done by bearing up the Helm, and then she will drive nothing so far to Lee-ward. They call it hulling also in a calm swelling Sea, which is commonly before a storm, when they strike their Sails lest she should beat them in pieces against the Mast by **Rowling**. We say a Ship doth **Labour** much when she doth rowl much any way; but if she will neither **Trie** nor **Hull**, then **spoon**, that is, put her right before the wind, this way although she will rowl more than the other, yet if she be weak, it will not strain her any thing so much in the **Trough** of the Sea, which is the distance betwixt two Waves or Billows. If none of this will do well, then she is in danger to **founder**, if not sink. **Foundering** is, she will neither veer nor steer, the Sea will so over-rake her, except you free out the water, she will lie like a Log, and so consequently sink. **To spend a Mast** or **Ward** is when they are broke by foul weather, and to **spring a Mast** is when it is cracked in any place.

In this extremity he that doth can the Ship, cannot have too much judgment, nor experience to **try her drift**, or how she

the **Caps**, which are two terms also used in the Trials of the running or setting of currants. A **poke** is when the Sea is so rough as that men cannot govern the Helm with their hands, and then they sease a block to the Helm on each side the end, and reeving two fals thorow them like Gunners Tackles, brings them to the Ship side, and so some being at the one side of the Tackle, some at the other, they steer her with much more ease then they can with a single rope with a double turn about the Helm.

When the Storm is past, though the wind may alter three or four points of the Compass, or more, yet the Sea for a good time will go the same way; then if your courle be right against it, you shall meet it right a head, so we call it a **Head Sea**. Sometimes when there is but little wind, there will come a contrary Sea, and presently the wind after it, whereby we may Judg that from whence it came was much wind, for commonly before any great Storm the Sea will come that way. Now if the Ship may run on shore in ose or mud she may escape, or Billage on a rock, or Anchors flook, repair her leak, but if she split or sink, she is a wrack. But seeing the Storm decreaseth, let us try if she will endure the **Hullock** of a Sail, which sometimes is a peice of the Misen-Sail or some other little Sail, part opened to keep her head to the Sea, but if yet she would weather coile, we will loose a Hullock of her fore-Sail, and put the Helm a weather, and it will bring her head where her stern is; courage my hearts.

It clears up, set your fore Sail; Now it is fair weather out with all your Sails, go **Larg** or **Uast**, that is, when we have a fresh gale, or fair wind, and all Sails drawing. But for more haste unparrel the Misen-Yard and lanch it, and the Sail over her Lee-quarrrter, and fir Gives at the further end to keep the Yard steady, and with a Boom, Boom it out; this we call a **Goose wing**. Who is at Helm there? Sirra, you must be amongst the Points; Well Master the Channel is broad enough; yet you cannot steer betwixt a pair of sheats; Those are words of mockery betwixt the Gunner and the Stearsman. But to proceed. G Get

Get your Larboard Tackles aboard, hale off your Starboard sheats, keep your course upon the Point you are directed. Port, he will lay her by the Lee; the stays, or backstays, that is, when all the Sails flutter in the wind, and are not kept full; that is full of wind, they fall upon the Mast and Shrouds, so that the Ship goes a drift upon her broad side, fill the Sails, keep full, full and by. Make ready to Tack about, is for every man to stand to handle the Sails and ropes they must hale. Tack about is to bear up the Helm and that brings her to stay all her Sails lying flat against the Shrouds, then as she turns we say she is payed, then let rise your Lee tacks, and hale off your Sheats, and trim all your Sails as they were before, which is cast off that Boling which was the weather-Boling, and hale up taut the other. So all your Sheats, Braces, and Tacks are trimmed by a wind as before. To belay, is to make fast the ropes in their proper places. **Round in**, is when the wind larges, let rise the main-tack and fore-tack, and hale aft the fore Sheat to the Cats-head, and the main Sheat to the cub-bridge head, this is **Rounding in**, or **Rounding aft** the Sail; the Sheets being there they hale them down to keep them firm from flying up with a **Palazado**; which is any rope wherewith we hale down the Sheats, blocks of the main or fore-Sail, when they are haled aft the clew of the main Sail to the Cubbridge head of the main Mast, and the clew of the fore-Sail to the Cat-head; Do this when the Ships goes large.

Observe, the height; that is, at twelve a clock to take the height of the Sun, or in the night the North Star, or in the forenoon and afternoon, if you miss these by finding the **Azimuth** and **Micantier**. **Dead-water** is the **Eddy water** follows the Stern of the Ship, not passing away so quickly as that slides by her sides. The **Wake** of a Ship is the smooth water a stern, shewing the way she hath gone in the Sea, by this we judge what way she doth make, for if the wake be right a stern, we know she makes good her way forwards; but if to Lee-ward a point or two, we then think

think to the Lee-ward of her course, but she is a nimble Ship, that in turning or tacking about will not fall to the Lee ward of her wake when she hath weathered it. **Disimbogue** is to pass some narrow straight or currant into the main Ocean out of some great Gulf or Bay. A **Drift** is any thing floating in the Sea that is of wood. **Rock-weed** doth grow by the shore, and is a sign of Land, yet it is oft found far in the Sea. Lay the Ship by the Lee to try the **Dip-sea line**, which is a small line, some hundred and fifty fathome long, with a long plummet at the end, made hollow, wherein is put tallow, that will bring up any gravel; which is first marked at twenty fathome, and after increased by tens to the end; and those distinguished by so many small knots upon each little string that is fixed at the mark throw the Strouds or midst of the line, shewing it is so many times ten fathome deep, where the **Plummet** doth rest from drawing the line out of your hand; this is only used in deep waters when we think we approach the shore, for in the Main Sea at 300. fathomes we find no bottom. Bring the Ship to rights, that is, again under Sail as she was; some use a **Log-line**, and a minute glass to know what way she makes, but that is so uncertain, it is not worth the labour to try it.

One to the Top to look out for **Land**, the man cries out **Land to**; which is just so far as a **Kenning**, or a man may discover, descry, or see the Land. And to **Lay a Land** is to sail from it, just so far as you can see it. A **good Land fall** is when we fall just with our reckoning, if otherwise a **Bad Land fall**; but however how it bears, set it by the Compass, and bend your Cables to the Anchors, A **Head-Land**, or a **Point of Land** doth lie further out at Sea than the rest. A **Land mark**, is any Mountain, Rock, Church, Windmill or the like, that the Pilot can know by comparing one by another how they bear by the Compass. A **Reach** is the distance of two Points so far as you can see them in a right line, as *White-Hall* and *London-bridge*, or *White-Hall* and the end of *Lambeth* towards *Chelsey*. Fetch the

Sounding-line.

Sounding-line, this is bigger than the Dipfie-line, and is marked of two fathom next the lead with a piece of black leather, at three fathom the like, but slit; at 5 fathom with a piece of white cloth; at 7 fathom with a piece of red in a piece of white leather; at 15 with a white cloth, &c. The **Sounding lead** is six or seven pound weight, and near a foot long, he that doth heave this lead stands by the horse, or in the chains, and doth sing fathom by the mark 5. o. and a **shaftment** less, 4. o. this is to find where the Ship may fail by the depth of the water. **Foul water** is when she comes into shallow water where she raises the sand or oſe with her way, yet not touch the ground, but she cannot feel her helm so well as in deep water.

Bear in.

When a Ship sails with a large wind towards the land, or a fair wind into a harbour, we say she **Bears in** with the land or harbour. And when she would not come near the land, but goeth more Room-way then her course, we say she bears off; but a Shipboard, **Bear off** is used to every thing you would thrust from you. **Bear up** is to bring the Ship to go large or before the wind. To **Hold off** is when we heave the Cable at the Capstern, if it be great and stiffe, or slimy with oſe, it surges or slips back unless they keep it close to the whelps, and then they either hold it fast with rippers, or brings it to the Jears Capstern, and this is called Holding off. As you approach the shore, shorten your Sails, when you are in Harbour take in your Sails, and come to an anchor, wherein much judgement is required.

Neale to.

To know well the soundings, if it be **Pealed to**, that is, deep water close aboard the shore, shallow, or if the Lee under the weather shore, or the Lee shore be sandy, clay, oſe, or fowl and rocky ground, but the Lee shore all men would shun that can avoid it. Or a **Road** which is an open place near the shore. Or the **Offing** which is the open Sea from the shore, or the midst of any great stream is called the offing. **Land lock**, is when the land is round about you.

A Road:
Offing.

Land locked.

To Ride.

Ride a great
Road,

Now the Ship is said to **Ride**, so long as the Anchors do hold and comes not home. To **Ride a great Road** is when the

the wind hath much power. They will strike their Top-Masts, and the Yards alongſt Ships, and the deeper the water is, it requires more Cable; when we have rid in any distress we say **we have rid halſe full**, because the water broke into the Hawſes, To **Ride betwixt wind and tide**, is when the wind and tide are contrary and of equal power, which will make her rowle extreamly, yet not strain much the Cable. To **ride thwart** is to ride with her side to the tide, and then she never strains it. To **ride apike** is to pike your Yards when you ride amongst many Ships. To **ride croſſe** is to hoise the Main and fore-Yards to the hounds, and topped alike. When the water is gone and the Ship lies dry, we say she is **Selwed**; if her head but lie dry, she is **Selwed a head** but if she cannot all lie dry, she cannot **Sew** there. **Water horn** is when there is no more water then will just bear her from the ground. The **water line** is to that Bend or place she should swim in when she is loaded.

Ride a stress.
Ride betwixt
wind and
tide.Ride thwart
tide.
Ride a pike.
Ride croſſe.Sewed:
Sew.
Water born.
Water line.

Lastly, to **Moar** a Ship is to lay out her anchors as is most fit for her to ride by, and the ways are divers; as first, to Moar a fair Berth from any annoiance. To **Moar a croſſe** is to lay one anchor to one side of the stream, and the other to the other right against one another, and so they bear equally Ebb and Flood. To **Moar alongſt** is to lay an anchor amidst the stream ahead, and another a stern, when you fear driving a shore. **Water shot** is to moar quartering betwixt both nether croſs, nor alongſt the tide. In an open road they will moar that way they think the wind will come the most to hurt them. To **Moar a Provise**, is to have one Moar Provise anchor in the river, and a hawser a shore, which is moared with her head a shore; otherwise two Cables is the least and four Cables the best to moar by.

To Moare.

Moar croſſe.

Moar alongſt.

Water shot.

Moar Provise.

C H A P. X.

Proper terms for the Winds, Ebbs, Floods, and Eddies, with their definitions, and an estimate of the Depth of the Sea, by the Height of the Hills and the largeness of the Earth.

When there is not a breath of wind stirring, it is **A Calm** or a **stark Calm**. **A Breeze** is a wind blows out of the Sea, and commonly in fair weather beginning about nine in the morning, and lasteth till neer night; so likewise all the night it is from the shore, which is called a **Turnado**, or a Sea turn, but this is but upon such coasts where it bloweth thus most certainly, except it be a storm, or very foul weather, as in *Barbary*, *Egypt*, and the most of the *Levant*. We have such Breezes in most hot countrys in Summer, but they are very uncertain. **A fresh Gale** is that doth presently blow after a calm, when the wind beginneth to quicken or blow. **A fair Loom Gale** is the best to Sail in because the Sea goeth not high, and we bear out all our Sails. A stiffe gale is so much wind as our Top-sails can endure to bear. **An Eddy-wind** is checked by the Sail, a Mountain, turning, or any such thing that makes it return back again. **It over blows** when we can bear no Top-sails. A flaw of wind is **A Gust** which is very violent upon a sudden, but quickly endeth. **A Spout** in the *West Indies* commonly falleth in those Gusts, which is, as it were, a small river falling entirely from the clouds, like out of our water Spouts, which make the Sea where it falleth rebound in flashes, exceeding high. **Whirl-winds** running round, and bloweth divers wayes at once. **A Storm** is known to every one not to be much

A Calm.
A Breeze.

Turnado.

A fresh Gale.

A Loom.
gale.

Eddy-wind.
It over blows.

A Gust.
A Spout.

A whirl-wind.
A Storm.

much less than a **tempest**, that will blow down Houses, and Trees up by the roots. **A Mounfoune** is a constant wind in the *East Indies*, that bloweth always three Months together one way, and the next three Months the contrary way. **A Hericano** is so violent in the *West-Indies*, it will continue three, four, or five weeks, but they have it not past once in five, six, or seven years; but then it is with such extremity, that the Sea flies like rain, and the waves so high, they over-flow the low Grounds by the Sea, insomuch, that Ships have been driven over tops of high Trees there growing, many Leagues into the Land, and there left, as was Captain *Francis Nelson* an *Englishman*, and an excellent Seaman for one.

We say a calm Sea, or **Becalmed**, when is so smooth the Ship moves very little, and the men leap over board to swim. **A Rough Sea** is when the waves grow high. **An over-grown Sea** when the **Surges** and **Billows** go highest. The **Rut** of the Sea, where it doth dash against any thing. And the **Roaring of the Sea** is most commonly observed a shore, a little before a storm or after a storm.

Flood is when the water beginneth to rise, which is **young Flood** as we call it, then **Quarter-flood**, **Half-flood**, **Full-Sea**, **Still water**, or **High-water**. So when it **Ebbs**, **Quarter-ebb**, **Half-ebb**, **three Quarter-ebb**, **Low-water**, or **Dead Low water**, every one doth know; and also that as at a **Spring-tide** the Sea or water is at the **highest**, so at a **Neape-tide** it is at the **lowest**. This word **Tide**, is common both to **Flood** and **Ebb**; for you say as well **Tide of Ebb**, as **Tide of Flood**, or a **windward Tide**, when the **Tide runs against the Stream**, as a **Leeward Tide**, that is, when the wind and the Tide goeth both one way, which makes the water as **smooth** as the other **rough**. To **Tide over to a place**, is to go over with the Tide of Ebb or Flood, and stop the contrary by **Anchoring** till the next Tide, thus you may work against the wind if it over-blow not. A **Tide-gate** is where the Tide runneth strongest. It flows Tide and half-Tide, that is, it will be half-Flood by the shore, before it begin to flow in the.

A Tempest.
A Mounfoune.

A Hericano.

Becalmed.

A Rough Sea.
An overgrown Sea.

Surges.
The Rut of the Sea.
The roaring of the Sea.
Floods and Ebbs.

A Tide of Ebb.
A Tide of Flood.
A windward Tide.
A Leeward Tide.
To Tide over.
A Tide-gate.
Tide, and half-Tide.

Eddie-Tide.

the Channel ; for although the Tide of Flood run aloft, yet the Tide of Ebb runs close by the ground. An **Eddie-Tide** is where the water doth run back contrary to the Tide, that is, when some Headland or great Point in a River hindereth the free passage of the stream, that causeth the water on the other side the Point to turn round by the shore as in a Circle, till it fall into the Tide again.

As touching the reasons of Ebbs and Floods, and to know how far it is to the bottom of the deepest place of the Sea, I will not take upon me to discourse of ; as knowing the same to be the secrets of God unrevealed to man : only I will let down a Philosophical speculation of divers mens opinions touching the depth of the Sea ; which I hope will not be thought much impertinent to the subject of this Book by the Judicious Reader.

The height of
Mountains
perpendicular.

Fabianus in *Pliny*, and *Cleomides* conceived the depth of the Sea to be fifteen Furlongs, that is, a Mile and $\frac{3}{4}$ parts. *Plutarch* compared it equal to the highest Mountains ; *Scaliger* and others conceived the Hills far surpassed the deepness of the Sea, and that in few places it is more than a hundred paces in depth, it may be he meant in some narrow Seas, but in the main Ocean experience hath taught us it is much more than twice so much, for I have sounded 300 fathom, yet found no ground. *Eratosthenes* in *Theon* that great Mathematician writeth the highest Mountain perpendicular is but ten Furlongs, that is, one Mile and a quarter. Also *Diocærcus* affirmeth this to be the height of the Hill *Pelius* in *Theffalia*, but *Xenagoras* in *Plutarch* observed the height of *Olympus* in the same region to be twenty paces more, which is 1270. paces, but surely all those mean only those Mountains in or about *Greece*, where they lived and were best acquainted ; but how these may compare with the *Alpes*, in *Asia*, *Atlas* in *Africa*, *Caucasus* in *India*, the *Andes* in *Peru*, and divers others hath not yet been examined.

The height of
the Hills com-
pared with the
Superficies of
the Earth and
depth of the
Sea.

But whatsoever the Hills may be above the Superficies of the Earth, many hold opinion the Sea is much deeper, who
sup-

suppose that the Earth at the first framing was in the Superficies regular and Spherical, as the Holy Scripture directs us to believe ; because the water covered and compassed all the face of the Earth, also that the face of the Earth was equal to that of the Sea. *Damascene* noteth, that the unevenness and irregularity, which now is seen in the Earth's Superficies, was caused by taking some parts out of the upper face of the Earth in sundry places to make it more hollow, and lay them in other places to make it more convex, or by raising up some part, and depressing others to make room and receipt for the Sea, that mutation being wrought by the power of the word of the Lord, *Let the waters be gathered into one place, that the dry land may appear.* As for *Aquinas*, *Dionysius*, *Catharianus*, and some Divines that conceived there was no mutation, but a violent accumulation of the waters, or heaping them up on high is unreasonable ; because it is against nature, that water being a flexible and a ponderous body, so to consist and stay it self, and not fall to the lower parts about it ; where in nature there is nothing to hinder it ; or, if it be restrained supernaturally by the hand and bridle of Almighty God, lest it should overwhelm and drown all the Land, it must follow, that God even in the very institution of Nature imposed a perpetual violence upon Nature. And this withal, that at the Deluge there was no necessity to break up the Springs of the Deep, and to open the Cataracts of Heaven, and pour down water continually so many days and nights together, seeing the only withdrawing of that hand, or letting go of that bridle which restraineth the water, would presently have overwhelmed all.

But both by Scriptures, the experience of Navigators, and reason, in making estimation of the depth of the Sea, reckon not only the height of the Hills above the common Superficies of the Earth, but the height of all the dry Land above the Superficies of the Sea, because the whole mass of Earth that now appeareth above the waters, being taken as it were out of the places which the waters now possess,

How all the
Hills and dry
land above the
Superficies of
the Sea hath
made room for
the Sea, there-
fore they are
in equal
height and
depth.

H

must

must be equal to the place out of which it was taken; so consequently it seemeth, that the height or elevation of the one should answer the descending or depth of the other; and therefore in estimating the depth of the Sea, we consider not only the erection of the Hills above the ordinary land, but the advantage of the dry land above the Sea; which latter, I mean the height of the ordinary main-land, excluding the Hills, which properly answer the extraordinary Deepes and Whirl-pools in the Sea. The rest is held more in large Continents above the Sea, than that of the Hills is above the land.

That there is small difference betwixt the springs first rising out of the Earth, and their falling into the Sea.

For that the plain face of the dry land is not level, or equally distant from the Center, but hath a great descent towards the Sea, and a rising towards the midland parts, although it appear not plainly to the eye, yet to reason it is most manifest; because we find that part of the Earth the Sea covereth descendeth lower and lower towards the Sea. For the Sea, which touching the upper face of it, is known by nature to be level, and evenly distant from the Center, is observed to wax deeper and deeper, the further one saileth from the shore towards the main Ocean: even so in that part which is uncovered, the streamings of Rivers on all sides from the Midland parts towards the Sea, sliding from the higher to the lower, declareth so much, whose courses are some 1000. or 2000 miles, in which declination, *Pliny* in his derivation of water requireth one cubit of declining in 240 foot of proceeding. But *Columella*, *Vitruvius*, *Paladius*, and others, in their conduction of waters require somewhat less; namely, that in the proceeding of 200. foot forward, there should be allowed one foot of descending downward, which yet in the course of 1000. miles, as *Danubius*, *Volgha*, or *Indus*, &c. have so much or more, which will make five miles of descent in perpendicular account, and in the course of 2000. or more, as *Nilus*, *Niger*, and the River of the *Amazons*, have ten miles or more of the like descent.

The determination of these questions.

These are not taken as rules of necessity, as though water could not run without that advantage, for that respect the con-

conveyers of waters in these times content themselves with one Inch in 600. foot, as *Philander* and *Vitruvius* observed, but is rather under a rule of commodity for expedition and wholesomeness of water so conveyed, lest resting too long in Pipes it should contract some unwholesome condition, or else through the slackness of motion, or long closeness, or banishment from the air, gather some aptness and disposition to putrifie. Although I say, such excess of advantage as in the Artificial conveyance of Waters the forenamed Authors require, be not of necessity exacted in the natural derivation of them, yet certain it is, that the descent of Rivers being continually, and their course long, and in many places swift; and in some places headlong and furious; the differences of height or advantage cannot be great betwixt the springs of the Rivers, and their outlets, betwixt the first rising out of the Earth, and their falling into the Sea: unto which declivity of land, seeing the deepness of the Sea in proportion answer, as I before declared, and not only to the height of the Hills: it is concluded, that the deepness to be much more than the Philosophers commonly reputed: and although the deepness of the *Sardinian* Sea, which *Aristotle* saith, was the deepest of the *Mediterranean*, recorded by *Posidonius* in *Strabo*, to have been found but 1000. fathom, which is but a mile and a fifth part, and the greatest breadth not past 600. miles: then seeing if in so narrow a Sea it be so deep, what may we esteem the main Ocean to be, that in many places is five times so broad, seeing the broader the Seas are, if they be intire and free from Islands, they are answerably observed to be the deeper. If you desire any further satisfaction, read the first part of *Purchas* his *Pilgrimage*, where you may read how to find all those Authors at large. Now because he hath taken near 100. times as much from me, I have made bold to borrow this from him, seeing he hath founded such deep Waters for this our Ship to sail in, being a Gentleman whose person I loved, and whose memory and virtues I will ever honour.

Note, the difference betwixt the springs of the Rivers, and their falling into the Sea is not great.

CHAP. XI.

Proper Sea terms belonging to the good or bad condition of Ships, how to find them and amend them.

A wholesome Ship.

A Ship that will try, hull, and ride well at Anchor, we call a **wholesome Ship**. A long Ship that draws much water will do all this, but if she draw much water, and be short, she may Hull well, but neither try nor ride well; if she draw little water and be long, she may try and ride well, but never Hull well, which is called an **unwholesome Ship**. The **Howling** in of a Ship is when she is past the breadth of her bearing she is brought in narrow to her upper works: it is certain this makes her wholesome in the Sea without rowling, because the weight of her Ordnance doth counterpoise her breadth under water, but it is not so good in a Man of War, because it taketh away a great deal of her room, nor will her Tacks ever so well come aboard as if she were laid out aloft, and not **flaring**, which is when she is a little Howling in, near the water, and then the upper work doth hang over again, and is laid out broader aloft, this makes a Ship more roomy aloft for men to use their arms in, but Sir *Walter Rawleigh's* proportion, which is to be proportionably wrought to her other work is the best, because the counterpoise on each side doth make her swim perpendicular or straight, and consequently steady, which is the best.

If a Ship be narrow, and her bearing either not laid out enough or too low, then you must make her broader and her bearing the higher by ripping off the Planks two or three

An unwholesome Ship. Howling a Ship.

Flaring.

three strakes under water, and as much above, and put on other Timbers upon the first, and then put on the Planks upon those Timbers, this will make her bear a better Sail, but it is an hinderance to her Sailing, this is to be done when a Ship is **Crank-sided**, and will bear no Sail; and is called **Furring**. Note also, that when a Ship hath a deep Keel it doth keep her from rowling. If she be floaty and her Keel shallow, put on another Keel under the first to make it deeper, for it will make her hold more in the water, this we call a **false Keel**. Likewise if her Stem be too flat to make her cut water the better, and not **gripe**, which is when she will not keep a wind well; fix another Stem before it, and that is called a **false Stem**, which will make her rid more way, and bear a better Sail. Also the **Run** of a Ship is as much to be regarded, for if it be too short and too full below, the water comes but slowly to the Rudder, because the force of it is broken by her breadth, and then to put a false Stem-post to lengthen her is the next remedy, but to lengthen her is better; for when a Ship comes off handsomely by degrees, and her Tuck doth not lie too low, which will hinder the water from coming swiftly to the Rudder, makes her she cannot steer well, and they are called as they are, a **good run or a bad**. When a Ship hath lost a piece of her Keel, and that we cannot come well to mend it, you must patch a new piece unto it, and bind it with a **Stirrump**, which is an Iron comes round about it, and the Keel up to the other side of the Ship, whereto it is strongly nailed with Spikes. Her **Rake** also may be a defect, which is so much of the Hull, as by a perpendicular line the end of the Keel is from the setting on of the Stem, so much as is without that forward on, and in like manner the setting in of her Stem-post. Your *Frenchmen* gives great Rakes forwards on, which makes her give good way, and keep a good wind, but if she have not a full Bow, she will pitch her Head extremely in the Sea. If she have but a small Rake, she is so bluff that the Seas meets her so suddenly upon the Bows she cannot cut the water much, but the longer a Ship is, the fuller should be her

Crank tide. Furring.

A false Keel. Gripe.

A false Stem. The Run.

A good Run. A bad Run. A Stirrup.

Her Rake.

Looms.

her Bow, but the mean is the best. The **Looming** of a Ship is her prospective, that is, as she doth shew great or little: Her water-draught is so many foot as she goes in the water, but the Ships that draw most water are commonly the most wholesome, but the least draught goes best but rolls most, and we say a Ship doth **Heel** on Starboard or Larboard, that is, to that side she doth lean most.

Heeld.

Overfet.
Overthrow.

To **Overfet** or **overthrow** a Ship, is by bearing too much Sail you bring her Keel upwards, or on shore overthrow her by grounding her, so that she falls upon one side; and we say a Ship is **walt** when she is not stiff, and hath not Ballast enough in her to keep her stiff. And **Wall-reared** when she is right built up, after she comes to her bearing it makes her ill shapen and unseemly, but it gives her within much room, and she is very wholesome, if her bearing be well laid out. The Mastting of a Ship is much to be considered, and will much cause her to sail well or ill, as I have related in the Mastting a Ship. **Iron-sick**, is when the Bolts, Spikes, or Nails are so eaten with rust they stand hollow in the Planks, and so makes her Leak, the which to prevent, they use to put Lead over all the Bolt-heads under water. Lastly, the trimming of a Ship doth much amend or impair her sailing, and so alter her condition. To find her **Trim**, that is, how she will sail best; is by trying her sailing with another Ship, so many Glasses trimmed a head, and so many a stern, and so many upon an even Keel; also the easing of her Masts and Shrowds, for some Ships will sail much better when they are slack than when they are taut.

Iron-sick.

Trim.

C H A P.

C H A P. XII.

Considerations for a Sea Captain in the choice of his Ship, and in placing his Ordnance. In giving Chafe, Boarding, and entring a Man of War like himself, or a defending Merchant-man.

IN Land-service we call a Man of War a Souldier, either on Foot or Horse, and at Sea a Ship, which if she be not as well built, conditioned, and provided, as near fitting such an Employment, as may be, she may prove (either) as a Horseman that knoweth not how to hold his Reins, keep his seat in his saddle and stirrups, carry his Body, nor how to help his Horse with leg and spur in a curvet, gallop, or stop; or as an excellent Horseman that knoweth all, this, mounted upon a Jade that will do nothing, which were he mounted according to his Experience, he would do more with that one, than half a dozen of the other, though as well provided as himself. But I confess, every Horseman cannot mount himself alike, neither every Seaman ship himself as he would, I mean not for outward Ornament, which the better they are, the less to be desired; for there cannot be a braver sight than a Ship in her Bravery, but of a competent sufficiency, as the business requireth. But were I to chuse a Ship for my self, I would have her sail well, yet strongly built, her Decks flush and flat, and so roomy that men might pass with ease; her Bow and Chafe so Gally like contrived, should bear as many Ordnance as with conveniency she could, for that always cometh most to fight, and so stiff, she should bear a stiff Sail, and bear out her lower Tier in any reasonable weather; neither should her Gun room be unprovided; not manned like a Merchant-man, which if they

How to chuse a Ship fit to make a Man of War.

they be double manned, that is, to have twice so many men as would sail her, they think it is too many, in regard of the charge, yet to speak true, there are few Merchant Ships in the World do any way exceed ours. And those men they entertain in good Voyages, have such good Pay, and such acquaintance one with another in shipping themselves, that thirty or forty of them would trouble a Man of War with three or four times their number manned with Prest Men, being half of them scarce hale-Bouplings. Yea, and many times a Pirat, who are commonly the best manned, but they fight only for Wealth, not for Honour nor Revenge, except they be extremely contrained. But such a Ship as I have spoken of, well manned with rather too many than too few, with all sufficient Officers, Shot, Powder, Victual, and all their apurtenances, in my opinion, might well pass muster for a time of War.

His Reward
that first de-
scries a Ship,
or enters a
Prize.

How to give
chase, and
escape the
Chaser.

Now being at Sea, the Tops are seldom without one or other to look out for Purchase, because he that first descries a Sail, if she prove Prize, is to have a good Sute of Apparel, or so much Money as is set down by order, for his Reward; as also he that doth first enter a Ship, there is a certain Reward allowed him: When we see a Ship alter her course, and useth all the means she can to fetch you up; you are the Chase, and he the Chaser. In giving chase, or chasing, or to escape being chased, there is required an infinite Judgment and Experience, for there is no Rule for it; but the shortest way to fetch up your Chase, is the best. If you be too Lee-ward, get all your Tacks aboard, and shape your Course as he doth; to meet him at the nearest Angle you can; then he must either alter his Course, and Tack as you Tack as near the wind as he can lie, to keep his own till night, and then strike a Hull, that you may not descry him by his Sails, or do his best to lose you in the dark; for look how much he falls to Lee-ward, he falls so much in your way. If he be right a-head of you, that is called a Stern-chase; if you weather him, for every man in chasing doth seek to get the Weather, because you cannot board him, except you weather him, he will lask,

or

or go large, if you gather on him that way, he will try you before the Wind; then if your Ordnance cannot reach him, if he can out-strip you, he is gone. But suppose you are to Windward, if he clap close by a wind, and there goes a-head-Sea, and yours a Lee-ward Ship, if you do the like your Ship will so bear against the Sea, she will make no way; therefore you must go a little more large, though you chase under his Lee till you can run a head.

Board and Board, is when two Ships lie together side by side, but he that knoweth how to defend himself, and work well, will so run his Ship, as force you to enter upon his quarter, which is the highest part of the Ship, and but the Misen Shrowds to enter by, from whence he may do you much hurt with little danger, except you fire him, which a Pirat will never do, neither sink you, if he can chuse, except you be able to force him to defend himself. But in a Sea-fight we call Boarding, in Boarding where we can; the greatest advantage for your Ordnance, is to board him thwart the Hawse, because you may use all the Ordnance you have on one side, and she only them in her Prow; but the best and safest **Boarding** for **entring**, is on the Bow, but you must be careful to clear the Decks with burning Granadoes, Fire-pots, Pouches of Powder, to which give fire by a Gun-powder Match, to prevent Trainsto the **Powder-chest**, which are long Boards joyned like a Triangle, with divers broad ledges on either side, wherein lieth as many Pebble stones or Beatch as can there lie; those being fired, will make all clear before them. Besides, in an extremity a man would rather blow up the quarter-Deck, half-Deck, Fore-castle, or any thing, than be taken by him he knows a mortal Enemy; and commonly there are more men lost in entering, if the Chase stand to her defence, in an instant, than in a long Fight, board and board, if she be provided of her close Fights. I confess, the charging upon Trenches, and the entrances of a Breach in a Rampire, are Attempts as desperate as a man would think could be performed, but he that hath tried himself as oft in the entring a resting Ship as I have done both them and the other,

Board and
board.

Boarding and
entring a Ship

Powder-chests

other, he would surely confess there is no such dangerous Service ashore, as a resolved resolute Fight at Sea. A Ships close Fights, are small ledges of Wood laid cross one another like the Grates of Iron in a Prisons-window, betwixt the main Mast, and the Fore-mast, and are called Gratings, or Nettings, as is said; which are made of small Ropes, much in like manner, covered with a Sail; the which to undo, is to heave a Kedger, or fix a Grapling into them, tied in a Rope, but a Chain of Iron is better, and sheering off will tear it in pieces, if the Rope and Anchor hold; some have used Sheer-hooks, which are Hooks like Sickles fixed in the ends of the Yards-arms, that if a Ship under sail come to board her, those Sheers will cut her Shrowds, and spoil her Tackling; but they are so subject to break their own Yards, and cut all the Ropes comes from the Top-sails, they are out of request. To conclude, if a Ship be open, presently to board her, is the best way to take her. But if you see your Chase strip himself into fighting Sails, that is, to put out his Colours in the Poop, his Flag in the Main-top, his Streamers or Pendants at the ends of his Yards-arms, furl his Spret-sail, pike his Mizen, and sling his Main yard, provide your self to fight. Now because I would not be tedious in describing a Fight at Sea, I have troubled you with this short Preamble, that you may the plainlier understand it.

Evident signs
that a Chase
will fight.

C H A P.

C H A P. XIII.

How to Manage a Fight at Sea, with the proper Terms in a Fight largely expressed, and the ordering of a Navy at Sea.

FOR this Master-piece of this Work, I confess I might do better to leave it to every particular mans conceit as it is, or those of longer practice or more experience, yet because I have seen many Books of the Art of War by Land, and never any for the Sea, seeing all men so silent in this most difficult service, and there are so many young Captains, and others that desire to be Captains, who know very little, or nothing at all to any purpose, for their better understanding I have proceeded thus far; now for this that follows, what I have seen, done, and conceived by my small experience, I refer me to their friendly constructions, and well advised considerations.

A Sail, how bears she or stands she, to Windward or Lee-ward; set him by the Compass; he stands right a head, or on the Weather-Bow, or Lee Bow, let flie your colours if you have a consort, else not. Out with all your Sails, a steady man to the helm, sit close to keep her steady, *give him chase* or fetch him up; he holds his own, no, we gather on him. Captain, out goes his Flag and Pendants, also his *Waste Clothes* and *Top-armings*, which is a long red Cloth about three quarters of a yard broad, edged on each side with Calico or white Linnen Cloth, that goeth round about the Ship on the out-sides of all her upper works fore and aft, and before the Cubbridge heads; also about the fore and main Tops, as well for the countenance and grace of the Ship, as to cover the men from being seen, he turlles and flings his

Many Books
of the Art of
War for the
Land, none for
the Sea.

To give chase.

Waste Clothes.
Top-armings.

Fighting Sails.
To hale a Ship.

How to begin
a Fight.

Main-yard, in goes his Sprit-sail. Thus they use to strip themselves into their ~~shot~~ **Sails**, or **Fighting Sails**, which is only the Fore sail; the Main and Fore top Sails, because the rest should not be fired nor spoiled; besides they would be troublesome to handle, hinder our fights and the using our Armes; he makes ready his close Fights fore and aft.

Master, how stands the Chase? Right on head I say; Well we shall reach him by and by; What's all ready? Yea, yea, every man to his Charge, dowlse your Top-sail to salute him for the Sea, hale him with a noise of Trumpets: Whence is your Ship? Of *Spain*: Whence is yours? Of *England*: Are you a Merchant, or a Man of War? We are of the Sea. He waves us to Leeward with his drawn Sword, calls amain for the King of *Spain*, and springs his Loufe, give him a Chase-piece with your Broad-side, and run a good berth a head of him; Done, done. We have the wind of him, and he tacks about, Tack you about also, and keep your Loufe, be yare at the helm, edg in with him, give him a volley of small shot, also your Prow and Broad-side as before, and keep your Loufe; He pays us shot for shot; Well, we shall requite him; What are you ready again? Yea, yea. Try him once more, as before: Done, done: Keep your Loufe, and load your Ordnance again: Is all ready? Yea, yea; edg in with him again, begin with your Bow-pieces, proceed with your Broad-side, and let her fall off with the wind, to give her also your full Chase, your Weather-Broadside, and bring her round that the Stern may also discharge, and your Tacks close aboard again: Done, done, the wind veers, the Sea goes too high to board her, and we are shot through and through, and between wind and water. Try the Pump, bear up the Helm; Master, let us breath and refresh a little, and sling a man over-board to stop the Leaks; that is, to truss him up about the middle in a piece of Canvas, and a rope to keep him from sinking, and his arms at liberty, with a Malet in the one hand, and a Plug lapped in Okum, and well Tarred in a Tarpawling-clout in the other, which he will quickly beat in to the hole or holes the Bullets made; What cheer-Mates?

How to sling a
man over-
Board.

is

is all well? All well, all well, all well; Then make ready to bear up with him again, and withal your great and small shot charge him, and in the smoke board him thwart the Hawse, on the Bow, mid-Ships, or rather than fall, on his Quarter, or make fast your Graplings if you can to his close Fights and shear off. Captain, we are fowl on each other, and the Ship is on fire, cut any thing to get clear, and smother the fire with wet Clothes. In such a case they will presently be such friends, as to help one the other all they can to get clear, lest they both should burn together and sink; and if they be generous, the fire quenched, drink kindly one to another; heave their Cans over-board, and then begin again as before.

Well, Master, the day is spent, the night draws on, let us consult. Chirurgeon, look to the wounded, and wind up the slain, with each a weight or Bullet at their Heads and Feet to make them sink, and give them three Guns for their Funerals. Swabber, make clean the Ship; Purser record their Names: Watch, be vigilant to keep your berth to windward that we lose him not in the night: Gunners, sponge your Ordnance; Souldiers, scowre your Pieces: Carpenters, about your Leaks; Boatswain and the rest, repair the Sails and Shrowds; and Cook, you observe your directions against the Morning watch: Boy, Holla Master, Holla, is the Kettle boiled? Yea, yea: Boatswain, call up the men to Prayer and Break-fast.

Boy, fetch my Cellar of Bottels, a Health to you all fore and aft, courage my hearts for a fresh Charge; Gunners, beat open the Ports, and out with your lower Tire, and bring me from the Weather-side to the Lee, so many Pieces as we have Ports to bear upon him. Master, lay him aboard Loufe for Loufe; Mid-ships men, see the Tops and Yards well Manned, with Stones, Fire-pots, and Brass-balls; to throw amongst them, before we enter, or if we be put off, charge them with all your great and small shot, in the smoke let us enter them in the Shrowds, and every Squadron at his best advantage; so sound Drums and Trumpets, and St. George for *England*.

A consultation
and direction
in a Sea-fight,
and how they
bury their
dead.

A preparation
for a fresh
Charge.

They

How a prize
doth yeild,
and how to
entertain him
Seaman like.

They hang out a Flag of Truce, hale him a main, abase, or take in his Flag, strike their Sails and come aboard with their Captain, Purser and Gunner, with their Commission, Cocker, or Bills of Loading. Out goes the Boat, they are lanchd from the Ship-side, entertain them with a general cry, God save the Captain and all the Company, with the Trumpets sounding, examine them in particular, and then conclude your conditions, with feasting, freedom, or punishment, as you find occasion; but always have as much care to their Wounded as your own, and if there be either young Women or Aged-men, use them nobly, which is ever the nature of a generous disposition. To conclude, if you surprize him, or enter perforce, you may stow the men, riste, pillage, or sack, and cry a Prize.

How to call a
Council of
War, and or-
der a Navy
at Sea.

To call a Council of War in a Fleet: There is your Council of War to manage all busineses of import, and the Common Council for matters of small moment, when they would have a meeting, where the Admiral doth appoint it; if in the Admiral, they hang but a Flag in the main-Shrowds; if in the Vice Admiral, in the Fore-shrowds; if in the Rear-Admiral, in the Mizen: If there be many Squadrons, the Admiral of each Squadron upon sundry occasions doth carry in their main-Tops, Flags of sundry Colours, or else they are distinguished by several Pendants from the Yard-arms; every night or morning they are to come under the Lee of the Admiral to salute him and know his pleasure, but no Admiral of any Squadron is to bear his Flag in the main Top, in the presence of the Admiral-General, except the Admiral come aboard of him to Council, to Dinner, or Collation, and so any Ship else where he so resideth during that time, is to wear his Flag in the main Top. They use to martial or order those Squadrons in ranks like Manaples, which is four square, if the Wind and Sea permits, a good berth or distance from each other, that they be calm not one another, nor come not foul of each other; the General commonly in the midst, his Vice Admiral in the front, and his Reer Admiral in the Reer; or otherwise like a half Moon, which

which is two Squadrons like two Triangles for the two Horns, and so the rest of the Squadrons behind each other a good distance, and the General in the midst of the half Circle, from whence he seeth all his Fleet, and sendeth his directions, as he finds occasion to whom he pleaseth.

Now between two Navies they use often, especially in a Harbour or Road where they are at Anchor, to fill old Barks with Pitch, Tarr, Train-oyl, Lynseed-oyl, Brimstone, Rozin, Reeds, with dry Wood, and such Combustible things, sometimes they link three or four together in the night, and put them adrift as they find occasion. To pass a Fort some will make both Ships and Sails all black, but if the Fort keep but a fire on the other side, and all the pieces point blank with the fire, if they discharge what is betwixt them and the fire, the shot will hit, if the Rule be truly observed; for when a Ship is betwixt the fire and you she doth keep you from seeing it till she be past it. To conclude there is as many stratagems, advantages, and inventions to be used as you find occasions, and therefore experience must be the best Tutor.

C H A P. XIV.

How they divide their shares in a man of War, what Books and Instruments are fit for a Sea-man, with divers advertisements for Sea men, and the use of the Petty Tally.

THe Ship hath one third part. The Victualler the other third. The other third part is for the Company, and this is subdivided thus in shares.

Shares.

The Captain hath	10	In some but 9
The Lieutenant	9	or as he agreeth with the Captain.
The Master	8	In some but 7
The Mates	7	5
The Chyrurgion	6	3
The Gunner	6	5
The Boatswain	6	5
The Carpenter	6	5
The Trumpeter	6	5

(k)

The

The 4 quarter Masters	5	a piece, or	4
The Cooper	5		4
The Chyrurgions Mate	5		4
The Gunners Mate	5		4
The Carpenters Mate	5		4
The Corporal	4		3
The quarter Gunners	4		3
The Trumpeters Mate	3		3
The Steward	4		3
The Cook	4		3
The Coxswain	4		3
The Swabber	4		3

In *English* Ships they seldom use any Marshal, whose shares amongst the *French* is equal with the Boatswains, all the rest of the Younkers, or Fore-mast-men according to their deserts, some three, some two and a half, some one and a half, and the Boys one, which is a single share, or one and a half, or as they do deserve.

Now the Master, or his right hand Mate, the Gunner, Boatswain, and four Quarter Masters do make the shares, not the Captain who hath only this priviledge, to take away half a share, or a whole share at most, to give from one to another as he best pleaseth.

For to learn to observe the Altitude, Latitude, Longitude, Amplitude, the Variation of the Compass, the Suns Azimuth and Almicanter, to shift the Sun and Moon, and know the Tides, your Rombs, prick your Card, lay your Compass, get some of these Books, but practice is the best.

Master *Wrights* Errors of Navigation.

Master *Taps* Sea-mans Kalendar.

The Art of Navigation.

The Sea Regiment.

The Sea-mans Secret:

Master *Gunters* Works.

The Sea-mans Glas for the Scale.

The New Attractive for Variation.

Master *Wright* for use of the Globe.

Master *Hewes* for the same.

Instruments

Instruments fitting for a Sea-man,

Compasses so many Pair and Sorts as you will, an *Astrolabe* *Quadrant*, a *Cross-staff*, a *Back staff*, an *Astrolabe*, a *Nocturnal*.

A young Gentleman that desires command at Sea, ought well to consider the condition of his Ship, Victuals, and Company, nor must there be more Learners than Sailers, how slightly soever many esteem Sailers, for all the work to save Ship, Goods and lives must lie upon them, especially in foul weather, then their labour, hazard, wet and cold is so incredible I cannot express it. It is not then the number of them that here can say at home, what I cannot do I can quickly learn, and what a great matter it is to Sail a Ship, or go to Sea; surely those for some time will do more trouble than good, I confess it is most necessary such should go, but not too many in one Ship, for if the labour of threescore should lie upon thirty, (as many times it doth) they are so over-charged with labour, bruises, and over-straining themselves they fall Sick of one disease or other, for there is no dalying nor excuses with Storms, Gusts, over-grown Seas, and Lee-shores, and when their victuals is putrified it endangers all: Men of all other professions in Lightning, Thunder, Storms and Tempests, with Rain and Snow, may shelter themselves in dry houses by good fires, but those are the chief times Seamen must stand to their Tackling, and attend with all diligence their greatest labour upon the Decks. Many suppose any thing is good enough to serve men at Sea, and yet nothing sufficient for them ashore, either for their healths, for their ease, or estate; A Commander at Sea should do well to think the contrary, and provide for himself and company in like manner; also seriously to consider what will be his charge to furnish himself at Sea with Bedding, Linnen, Arms, and Apparel, how to keep his Table aboard, and his expences on shore, and provide his *Petty-Cash*, which is a competent proportion (according to your number) of these particulars following.

Fine wheat flower clove and well packed, *Rice*, *Currants*, *Sugar*,

Advertisements for young Commanders, Captains, and other Officers.

The Petty-Cash.

gar, Prunes, Cynamon, Ginger, Pepper, Cloves, green-Ginger, Oil, Butter, Holland-Cheese, or old Cheese, Wine, vinegar, Canary Sack, Brandy, the best Wines, the best Water, the juyce of Limmons for the scurvy, white-Bisket, Oatmeal, Gammons of Bacon, dryed Neats tongues, Beef packed up in Vineger, Legs of Mutton, minced and stewed, and close packed up, with tried Semet or Butter in earthen pots. To entertain Strangers, Marmalade, Suckets, Almonds, Confits and such like.

Some it may be will say I would have men rather to feast than fight; But I say the want of those necessities occasions the loss of more men than in any English Fleet hath been slain since 88. For when a man is ill, or at the point of death, I would know whether a dish of buttered Rice with a little Cynamon, Ginger, and Sugar, a little minced meet, or roast Beef, a few stew'd Prunes, a race of green Ginger, a *Plajack*, a Can of fresh water brewed with a little Cynamon, and Sugar, be not better than a little Poor John, or Salt Fish with Oil and Mustard, or Bisket, Butter, Cheese, or Oatmeal-pottage on Fish-days, or on Flesh days Salt Beef, Pork and Pease with six shillings beer, this is your ordinary Ships allowance, and good for them that are well if well conditioned which is not always, as Seamen can (too well) witness. And after a storm, when poor men are all wet, and some have not so much as a cloth to shift them, shaking with cold, few of those but will tell you, a little Sack or Brandy is much better to keep them in health, than a little small Beer or cold water although it be sweet. Now that every one should provide things for himself, few of them have either that providence or means, and there is neither Ale-house Tavern, nor Inn to burn a Faggot in, neither Grocer, Poulterer, Apothecary, nor Butchers Shop, and therefore the use of this Petty Tally is necessary, and thus to be employed as there is occasion. To entertain Strangers, as they are in quality every Commander should shew himself as like himself as he can, as well for the credit of the Ship, and his Setters forth as himself; but in that herein every one may moderate themselves according to their own pleasures, therefore I leave it to their own discretions, and this brief Discourse, and my self to their friendly construction, and good opinion. C H A P.

The Foremast and Rigging.

- | | |
|-------------------------------|---|
| 1 Foremast and Topmast. | 21 Fore Stay. |
| 2 Fore yard and Sail. | 22 Fore Topmast Stay. |
| 3 Fore Topfail yard and Sail. | 23 Fore Topgallant Stay. |
| 4 Topgallant yard and Sail. | 24 Horse for the fore Topfail Yard. |
| 5 Fore Lifts. | 25 Fore Topgallant Clewlines. |
| 6 Fore Topfail Lifts. | 26 Fore Topmast Backstales. |
| 7 Fore Topgallant Lifts. | 27 Fore Chains and Plates. |
| 8 Cross-trees and Cap. | 28 Fore Topfail Leathlines. |
| 9 Fore Braces. | 29 Fore Topfail Buntlines. |
| 10 Fore Topfail Braces. | 30 Fore Leathlines. |
| 11 Fore Topgallant Braces. | 31 Fore Buntlines. |
| 12 Fore Sheets and Tacks. | 32 The Fore Topfails Tye and Jeer. |
| 13 Fore Bowlines. | 33 The Yard of the fore Topfail. |
| 14 Fore Topfail Bowlines. | 34 The fore Horse and Tackle. |
| 15 Fore Topgallant Bowlines. | 35 The foretop Gallantfails Tye and Jeer. |
| 16 Fore Clewgarrets. | 36 The fore Tacks. |
| 17 Fore Topfail Clewlines. | |
| 18 Fore Shrowds. | |
| 19 Fore Topmast Shrowds. | |
| 20 Fore Topgallant Shrowds. | |

The Bowsprit and Rigging.

- | | |
|------------------------------------|--|
| 1 Bowsprit. | 6 Spritfail Sheets. |
| 2 Spritfail yard and Sail. | 7 Standing Lifts for the Spritfail yard. |
| 3 Spritfail Top and Cross-trees. | 8 Spritfail Braces. |
| 4 Spritfail Topfail yard and Sail. | 9 Spritfail Sheets. |
| 5 Spritfail Topmast. | 10 Spritfail Clewlines. |
| | 11 Spritfail Topfail Braces. |
| | 12 Sprit |

- | | |
|--------------------------------|---------------------------------------|
| 12. Spritsail Topfail Lifts. | 22 The main Spritsail. |
| 13 Spritsail TopmaltShrowds. | 23 The main Sprittails Tye and Jeers. |
| 14 Jack Staff and Jack. | 24 The Spritsail Topfails Clewlines. |
| 15 The Ships Head. | 25 The Spritsail Topfails Jeer. |
| 16 The Cat Head. | 26 The Spritsail Topfails Growfoot. |
| 17 The Harfles. | 27 The Trens Bowspritt. |
| 18 The fore Castle. | |
| 19 The Crain line. | |
| 20 The Horfe on the Bow-sprit. | |
| 21 Steeps on the Side. | |

C H A P.

CHAP. XV.

An Alphabetical Table of the Names of all the Parts or Members of a Ship, and its Appurtenances, with the Number of the Page in which the Term (or Word) here form'd, is Explained at Large.

A		Page.	Bolts, viz		Page.
A	Wning	26	— Ring	}	5
			— Set		
			— Clinch		
		29	— Rag		
			— Forelock		
			— Fend		
An An- chors.	Beam	29	— Drive	}	9
			Bowe, broad-Bowe narrow-Bowe		
			Beake, Beake-head		10
			Bits		10
Anchor, Sheat Anchor, stream Anchors,	Bow Anchor	29	Block, Fish-block	}	11
			Bulke, Bulks head		
			Brackets		11
A loof, keep your loof	Socket	37	Bittacle	}	11, 12
			Barnacles		
			Broning, or Breaming		13
B	Uttocks	4	Blocks, double-Blocks, vide	}	19
			Pullics		
			Block-snap		20
Beds	Billage	4	Brals	}	22
			Braces		
			Bolings, Boling-bridles, the Bo-		
But-ends	Bluffe	4	lins, check the Bowlings, 23	}	Bent
Beams	Bend wide Wale	6		}	K 2

Rigging, well Rigged, over	3	Sleepers	3
Rigged	18	Spurkits	3
Runnings	19	Spindle	8
Ratlings	19	Skupper, Skupper Leathers	9
Ropes, Breft Rope, ftanding		Sockets	11
Rope	20	Stearage	11
Bolt-Ropes	22	Shiver	19
Entering Rope, Bucket		Shrowds, Taut the Shrouds,	
Rope, Bolt-Ropes, Port		Eafe the Shrouds	19
Ropes, Jear-Ropes, Pre-		Sling or Slings	21
venter-Rope, Top-Rope	27	Sheats	22
Keel-Ropes, Rudder Rope,		Sinner	24
Car-Rope, Boy-Rope Boat-		Seafing	24
Rope, Cheft-Rope.	28	Seafen	25
Robins	21	Sarve, or Service	25
Reeve, and Reeveing	23	Spun yarn	25
Roufing	31	Splice, Spliceing, Room Splice,	
Rowling	40	Cut Splice	25, 30
Round in, Round aft	42	Shallop	26
Reach	43	Skiffe	26
Road	44	Spell	27
Ride, Ride a great Road,		Shearing	28
Ride a ftrefle, Ride be-		Swifting	28
tween Wind and Tide, Ride		S ern Fast	30
thwart Tide, Ride a Pike,		Shank-painter	31
Ride Croffe	44, 45	Stop	31
Rut of the Sea	47	Sails; Main-Sail, Fore-Sail,	
Roaring of the Sea	37	Main-Top-Sail, fore-Top-	
Rough Sea	47	Sail, Top gallant Sail, ftud-	
		ding-Sails, Mifen and Mi-	
		fen Top-Sail, Spret, and	
		Sprie-fail, Top-Sail, Drift-	
		Sail, Netting-Sail	31
		Head Sails, after-Sails	32
		Stantions	32
		Seam, Monk-Seam, Round-	
		Seam	32
		Stowage	

S

Stocks	1
Stem	2
Stern	2, 12
Sweep	3
Skarfing, or Skarfed	3

Stowage	33	Travas	12
Shoot	33	Tiller	12
Steward	35	Tarpawling	16, 26
Swabber	36	Trees, Croffe Trees, Trefsel	
Sailers	36	Trees	16
Steep Tubs	37	Waift Trees, Roufe Trees	32
Steering	37	Truck	17
Starboard	37	Tackle	20
Steady	37	Ties	21
Sheat or Courfe	39	Tackes	22
Spoon	40	Thoughts	26
Sea, a head Sea	41	Thowles	26
Surges	44	Tire of Ordnance, as the 1,	
Sew, Sewed	45	2 and 3 Tire	32
Spout	46	a half Tire	33
Storm	46	Trumpeter	35
Sea, a Rough Sea, an over-		Tally	38
grown Sea	47	Try	40
Surges	47	Trough	40
Ship: A wholfome Ship, an		Tempest	46
unwholfome Ship, How-		Tide, Tide of Ebbe, Tide	
ing a Ship, Flaring, Crank-		of Flood, a Windward Tide	
fided, Furring, false Keel,		a Leeward Tide, Tide o-	
Gripe, false Stern, the Run,		ver, Tide gate, Tide, and	
a good Run, a bad Run,		half Tide	47
a Stirup, her Rake, her		Eddy Tide	48
Loom, Heel'd, overfet,		Top Armings	59
Overthrow, Walt, Wall			
reared, Iron sick, Trim	52,		
	53, 54		

T

Timber, Rifeing Timber	3
Trunnions	4
Tuck	4
Transome	4

V

Viol	8
Vea, Vea, Vea, Vea	27
Veer, or the wind Veers	
Under the Sea	40

L

Wood

W	W	4	Water, dead-Water, Eddy	
			Water,	42
W	W	6	Foul Water	44
			Water born, Water Line,	45
W	W	8	Water shot	46
			Wirlwind	49
W	W	9	Waft-cloaths	52
W	W	12		Y
W	W	37	Y Arns, Rope-Yarns	24
			Younkers	36
W	W	40	Yare	37

CHAP. XVI.

Another Alphabetical Table, Explaining all the Principal Sea Terms used in work of a Ship in all Windes and Weathers.

A

AFT or *Aft*, fromward the Fore-part of the Ship, or toward the Stern, as *The Mast hangs aft*, that is towards the Stern.

How chear ye fore and aft, that is, how fares all your Ships Company.

Amain, a Word used by a Man of War to his Enemy, and signifies, *Yield*.

Strike Amain, that is, *Lower your Top-sails*.

The Anchor is a peek, that signifies the Anchor is right under the Hawse (or hole) through which the Cable belonging to the Anchor runs out.

The Anchor is a Cock-bell, that is, hangs up and down by the Ships side.

The

The Anchor is foul, that is, the Cable is got about the Fluke.
An Awning, A Sail or the like, supported like a Canopy over the Deck, to prevent the scorching heat of the Sun in hot Climates.

B

To bale, to lade Water out of the Ships Hold with Buckets, or the like.

Trench the Ballast, divide or separate it.

The Ballast shoots, that is, runs over from one side to the other.

To bear with the Land, &c. To sail towards it.

To bear in, that is, to sail before or with a Wind into a Harbour or Channel.

A Piece of Ordnance doth come to bear, that is, lies right with the Mark.

Bear up, a term used in conding the Ship, when they would have her sail more before the Wind.

Bear up round, put her right before the Wind.

To Belage, to make fast any running Rope.

To Bend a Cable, is to make it fast.

A Birth, a convenient space to moor a Ship in.

A Bight, any part of a Rope between the ends.

The Bilge, the breadth of the place the Ship rests on when she is a ground.

The Ship is bilged, that is, has struck off some of her Timber on a Rock or Anchor, and springs a Leak.

A Bitake, that whereon the Compass stands.

A Bitter, a turn of a Cable about the Bits.

The Bits, two Main-square pieces of Timber, to which the Cables are fastned when the Ship rides at Anchor.

A Bonnet, an Addition to another sail, when they fasten it on, they say, *Lace on the Bonnet*; and when they take it off, *Shuke off the Bonnet*; it is very rarely fastned to any other than the Mizon, Main, Fore-sail, and Sprit-sail, and those Sails are called *Courses*, as Main-course and Bonnet, not Main-sail and Bonnet.

A Boom, a long Pole used to spread out the Clew of the Studding-sail, &c.

Board and Board, a term used when two Ships come so near as to touch one another.

To go aboard, to go into a Ship.

To make a board, or *board it up*, is to turn to Windward.

To break Bulk, to open the Hold, and take out goods thence.

C

Careening, is bringing a Ship to lye down on one side while they trim and caulk the other.

Caulking, is driving of Ockham, Span-hair, and the like into all the seams of the Ship, to keep out Water.

To Chase, is to pursue another Ship, and the Ship so pursued is called the *Chase*.

To Comd or Cunn, is to direct or guide, and *to cun a Ship* is to direct the Person at Helm how to steer her: If the Ship go before the Wind, then he who cun the Ship uses these terms to him at Helm, *Starboard*, *Larboard*, *Port*, *Helm a Midships*. *Starboard*, is to put the Helm to the Starboard, (or right) side, to make the Ship go to the Larboard (or left;) for the Ship always sails contrary to the Helm. In keeping the Ship near the Wind, these terms are used, *Loof*, *Keep your Loof*, *Fall not off*, *Veer no more*, *keep her to*, *touch the Wind*, *have a care of the Lee-latch*. To make her go more large, they say, *Ease the Helm*, *no near*, *bear up*. To keep her upon the same Point, they use, *Steady*, or *as you go*, and the like. *The Ship goes Lasking*, *Quartering*, *Veering*, or *Large*; are terms of the same signification, viz. that she neither goes by a Wind nor before the wind, but betwixt both.

The Course, is that Point of the Compass on which the Ship sails: Also the Sails are called *Courses*.

Cut the Sail, that is, unfurl it, and let it fall down. *A sail is well cut*, that is, well fashioned.

D

D

Dead-water, the Eddy-water at the Stern of the Ship.

To Disembogue, is to go out of the Mouth or Strait of a Gulph.

To dispart, is to find out the Difference of Diameters of Metals betwixt the breech and mouth of a Piece of Ordnance.

The Deck is flush fore and aft, that is, is laid from stem to stern without any falls or risings.

E

End for End, a Term used when a Rope runs all out of the block, so that it is unreeved; as when a Cable (or Hawse) runs all out at the Hawse, we say, *the Cable at the Hawse is run out End for End*.

F

A Fathom, a Measure containing six Feet.

A Fack, is one Circle of any Rope or Cable quail'd up round.

To fathel (or furl) a Sail, is to wrap it up close together, and bind it with little strings called *Caskets*, fast to the Yard.

To fash a Mast, or *Yard*, is to fasten a piece of Timber or Plank to the Mast or Yard to strengthen it, which Plank is called a *Fish*.

To lower or strike the Flag, is to pull it down upon the Cap. and in Fight is a token of yielding; but otherwise of great respect.

To heave out the Flag, is to wrap it about the Staff.

Free the Boat, or *Ship*, is to bale or pump the water out.

G

The Ships Gage, is so many Foot as she sinks in the Water; or (to speak now like a Sea-man) so many Foot of Water as she draws.

L 3

Weather

Weather Gage, is when one Ship has the Wind (or is to weather) of another.

A loom Gale, a little Wind.

One Ship gales away from another. In fair weather when there is but little Wind that Ship which hath most Wind and sails fastest is said, to *gale* away from the other.

To greave a Ship, is to bring her to lye dry a ground, to burn off her old filth.

The Ship gripes, that is, turns her Head to the Wind more than she should.

H

To Hale, is the same as to pull.

To over Hale, is when a Rope is haled too stiff, to hale it the contrary way, thereby to make it more slack.

To hail a Ship, is to call to her Company to know whither they are bound, &c. and is done after this manner, *Hōa the Ship!* or only *Hōa!* To which they answer *Hāe*. Also to salute another Ship with Trumpets or the like, is called *Hailing*.

Fresh the Hawse, a term used when that part of the Cable that lies in the Hawse is fretted or chafed; and they would have more Cable veered out, that another part of it may rest in the Hawse. When two Cables that come through two several Hawses are twisted, the untwisting them is called *clearing the Hawse*. *Thwart the Hawse*, and *rides upon the Hawse*, are terms used when a Ship lies *thwart* or *cross*, or with her Stern just *before*, another Ships *Hawse*. Note, That the *Hawses* are the great Holes under the Head of the Ship, through which the Cables run when she lies at Anchor.

The Ship heels, that is, inclines more to one side than the other, as *she heels to Starboard*, that is, turns up her Larboard-side to lie down on the Starboard.

To Hitch, is to catch hold.

The Hold of a Ship, is that part betwixt the Keelson and the lower Deck, where all Goods, Stores, and Victuals do lie. *Runnidge the Hold*, is used for removing or clearing the Goods and things in the Hole. *Stowing the Hold*, is when they take goods into the Hold.

To

To Hoise, is to hale or lift up, as *Hoise the water in*, *Hoise up the Yards*.

Hulling, when a Ship is at Sea, and takes in all her Sails, she is said to *Hull*.

L

The Ship Labours, that is, rowls and tumbles much.

Land fall, is a term used, when we expect to see Land; as we had a good *Land fall*, that is made Land (or saw Land,) according to our Reckoning.

Land-locked, is when the Land lies round about us, so that no point is open to the Sea.

Land-to, A Ship is said to lie *Land-to*, when she is at so great a distance as only just to discern the Land.

To Lash, is to bind, as *Lash the Fish on to the Mast*, that is bind it to the Mast.

Launch, is to put out, as to *Launch a Ship*, is to put her forth of the Dock into the water, but it is sometimes likewise used in a Negative sense, as when a Yard is hoisted high enough, they usually call aloud *Launch-hōe*, that is-hoise no more.

To lay the Land, is to lose sight of it.

The Lee-shore, is that shore against which the Wind blows.

Have a care of the Lee-latch, that is take heed the Ship go not too much to Lee-wards.

A Ship lies by the Lee, that is, has all her sails lying flat against the Masts and Shrouds.

M

Mizon Sail, hath several words peculiar to it; as *Set the Mizon*, that is; fit the Mizon sail; *Change the Mizon*, that is, bring the Yard to the other side of the Mast; *Speak the Mizon*, that is, put the Yard right up and down by the Mast; *Spell the Mizon*, that is, let go the Sheet and peek it up.

To moor a Ship, is to lay out her Anchors in such a manner as is most convenient for her to ride by safely.

M

N

Neap tides, are the Tides when the Moon is in the second and last Quarter, and they are neither so high, nor so low, nor so swift as the Spring-tides.

A Ship is beneaped, a term used, when the water does not flow high enough to bring a ship from off the ground, or out of a Dock, or over a Bar.

O

The Offing, that is, fromward the shore, or out into the Sea; as *The Ship stands for the Offing*, that is, sails from the shore into the Sea. When a Ship keeps the middle of the Channel, and comes not near the shore, she is said to *keep in the Offing*.

Off-ward, is contrary to the shore; as the stern of a Ship lies to the Offward, and her head to the shore-ward, that is, her stern lies toward the Sea, and her head to the shore.

Overfet, is turning over, but if a Ship turn over on a side, when she is trimming a ground, it is called *overthrown*.

P

To Parcel a seam, is (after the Seam is caulked) to lay over it a narrow piece of Canvas, and pour thereon hot Pitch and Tar.

To Pay a seam, is to lay hot Pitch and Tar on (after Caulking) without Canvas.

To Ride a Peek, is when the Yards are so ordered, that they seem to make the Figure of St. Andrews Cross.

To Purchase, in a Ship bears the same sense as *draw* many times, as *the Captain purchases apace*, that is, draws in the Cable apace.

Q

Quarter Winds, are when the Wind comes in abaft the main-mast-shrouds even with the Quarter.

A

A Quoil, is a Rope or Cable laid up round one Fack over another, and the laying the Fack, is called *quoiling*.

R

A Reach, is the Distance between any two points of Land, that lie in a Right-line one from another.

To Reeve, is to put a Rope through a Block; and to pull a Rope out of a Block is called *unreeving the Rope*.

To Ride, When a ship's Anchor holds her fast, so that she does not drive with Wind or Tide, she is said to *ride at Anchor*.

To Ride athwart, is to ride with the Ships side to the Tide.

To Ride betwixt Wind and Tide, is when the Wind and Tide are contrary and have equal strength.

To Ride Hawse-fall, is when in a rough Sea the Water breaks into the Hawfles.

A Road, is any place near the Land where Ships may ride at Anchor, and a Ship riding there is called a *Roader*.

Rowse-in, (that is, Hale-in) proper only to the Cable or Hawser, and is used when the Cable or Hawser is slack to make it taut or straight.

S

A Sail. Besides its proper signification (as belonging to the several Yards, from which it takes its various Names, as Main-fail, &c.) it signifies also a Ship, as when at Sea we descry a Ship, we cry out, *A sail! A sail!* Likewise if we speak of a Fleet (or a number of Ships together) we say the Fleet consisted of 40 or 50 sail, and not 40 or 50 Ships.

To Serve a Rope, is to wind something about it, to keep it from fretting out.

To Seaze, is to make fast, or bind.

The Ship heels, that is, when on a sudden she lies down on her side, and tumbles from one side to the other.

The Ship sends, that is, her head or stern falls deep in the trough or hollow of the Sea.

M

To

To Settle a Deck, is to lay it lower.

The Ship is served, that is, the Water is gone from her.

The Ship shears, that is, goes in and out, and not right forward.

To Sound, is to try with a line or other thing how deep the Water is.

The Ship hath spent her Masts, that is, her Masts have been broke by foul Weather; but if a Ship lose her Masts in Fight, we say, *her Masts were shot by the Board*.

To Splice Ropes, is to untwist two ends of Ropes, and then twist them both together, and fasten them with binding a string about them.

The Sail is split, that is, blown to pieces.

The Ship spoons, that is, goes right before the wind without any sail.

Spring tides, are the Tides at New and Full-moon, which flow highest and ebb lowest, and run strongest.

The Bow-sprit Steeves, that is, stands too upright. *Steering* is likewise used by Merchants when they stow Cotton or Wool, which being forced in with skrews, they call *Steering* their Cotton or Wool.

T

Tack about, that is, bring the Ships head about to lie the other way.

Tallee aft the sheats, a term used for haling aft the sheats of the Main or Fore-sail.

A windward Tide, when the Tide runs against Wind.

A Leeward Tide, when the Wind and Tide go both one way.

A Tide gate, where the Tide run strong.

To Tide it up, is to go with Tide against the Wind, and when the Tide alters to lie at Anchor till it serve again.

It flows Tide and half Tide, that is, it will be High-water sooner by three hours at the shore than in the Offing.

To Tow, is to drag any thing after the Ship.

The Traverse, is the Ships way.

To

V

To Veer, is to let out; as *veer more Rope*, *veer more sheats*.

W

The Ship is Walt, that is, wants ballast.

To Weather a Ship, is to go to Windward of her.

To Wind a Ship, is to bring her head about.

How Winds the Ship, that is, upon what point of the Compass does she lie with her head.

To Would, is to bind Ropes about a Mast or the like, to keep on a Fish to strengthen it.

Y

The Ship Yaws, that is, goes in and out, and does not steer steadily.

M z

OF
G U N N E R Y.

B O O K II.

Being an Abstract of the Art of *Gunnery*, (or Shooting in *Great Ordnance* and *Mortar Pieces* :) Wherein the Principles of that Art are plainly Taught, both by Arithmetical Calculation, and by *Tables* ready Calculated. With the Compositions for the making of several *Fire Works*, useful in War both at *Sea* and *Land*.

C H A P. I.

Wherein is declared the Names of all sorts of Ordnance, and their Appurtenances, with an Explanation of their proper Terms; and divers Observations concerning Shooting in them.

A Cannon Royal, a Cannon, a Demi-Cannon, a Culvering, The Names of
 A Demi Culvering, a Saker, a Minion, and divers others: Ordnance.
 A Table of all which, with their Lengths, Weights, Charges, &c. you have in the Chapter following.

To all these belong **Carriages**, whereon Pieces do lie; Carriages supported by an Axletree betwixt two Wheels, whereon doth lie the Piece upon her **Trunnions**, which are two Trunnions. knobs cast with the Piece on each of her sides, which doth lie

Cap-squares.

Wheels.

Linch-pins.

Trucks.
To mount a
Piece.
To dismount a
Piece.
Beils.
Quoines.

Travas:
Dispart.
Mouth.
Britch.
Carnouse.
Muzzle.

Cylinder.
Concave.
Bore.

How to dispart
a Piece.

Taper bore.

Honycomb.

lie in two half holes upon the two Cheeks of the Carriages, to raise her up or down as you will; over them are the **Cap-squares**, which are two broad Pieces of Iron, doth cover them, made fast by a Pin with a fore lock to keep the Piece from falling out. That the Piece and Carriages is drawn along upon **Wheels** every one doth know, if she be for Land-service, they have Wheels made with Spokes like Coach-wheels, and according to their proportions strongly shod with Iron, and the Pins at the ends of the Axletree are called **Linch-pins**.

If for Sea she have **Trucks**, which are round intire Pieces of wood like Wheels. To **mount** a Piece is to lay her upon her Carriages; to **dismount** her, to take her down. Her **Bed** is a Plank doth lie next the Piece, or the Piece upon it upon the Carriage, and betwixt the Piece and it they put their **Quoines**, which are great wedges of wood with a little handle at the end to put them forward or backward for levelling the Piece as you please. To **Travas** a Piece is to turn her which way you will upon her Platform. To **dispart** a Piece is to find a difference betwixt the thickness of the metal at her **mouth** and **bitch**, or **carnouse**, which is the greatest circle about her Britch, and her **muzzle ring** is the greatest circle about her mouth, thereby to make a just shot, there are divers ways to dispart her, but the most easiest is as good as the best, and that is but by putting a little stick or a straw that is strait into the Touch-hole to the lower part of the **Cylinder** or **Concave**, which is the **Bore** of the Piece, and cut it off close by the metal, and then apply it in the same manner to the mouth, and it will exactly shew you the difference, which being set upon the muzzle of the Piece with a little Clay, Pitch, or Wax, it will be as the Pin of any Piece is to the sight, level to the Carnouse or Britch of the Piece, otherwise you may give her allowance according to your judgment.

Taper bored, is when a Piece is wider at the mouth than towards the britch, which is dangerous (if the Bullet go not home) to burst her. **Honycombed**, is when she is ill cast, or over much worn, she will be rugged within, which is dangerous

ous

ous for a Cross-bar Shot to catch hold by, or any rag of he wadding being a fire, and sticking there may fire the next Charge you put in her; and you may find it, if she be Taper-bored, either with a crooked wyer at the end of a long-staff, by scratching up and down to see where you can catch any hold, or a light Candle at the end of a staff thrust up and down to see if you can see any fault. **Bitchings** are the Ropes by which you lash your Ordnance fast to the Ships-side in foul weather. **Chambers** is a Charge made of Brass or Iron, which we use to put in at the britch of a Sling or Murtherer, containing just so much powder as will drive away the case of stones or shot, or any thing in her. In a great Piece we call that her Chamber, so far as the Powder doth reach when she is loaded.

A **Cartrage** is a Bag of Canvass made upon a frame or a round piece of wood somewhat less than the Bore of the Piece, they make them also of Paper, they have also Cartrages or rather Cases for Cartrages made of Lattin to keep the Cartrages in, which is to have no more Powder in them than just the Charge of your Piece, and they are closely covered in those **Cases of Lattin**, to keep them dry, and from any mischances by fire, and are far more ready and safer than your Ladles or **Budgebarrels**. A Budgebarrel is a little Barrel made of Lattin, filled with Powder to carry from place to place for fear of fire; in the cover it hath a long neck to fill the Ladles withal without opening. A **Ladle** is a long-staff with a piece of thin Copper at the end like half a Cartrage, in breadth and length so much as will hold no more Powder than the due Charge for the Piece it belongs to. A **Spunge** is such another staff, with a Piece of a Lambs skin at the end about it to thrust up and down the Piece, to take off the dust, moisture, or sparks of fire if any remain in her. And a **Rammer** is a bob of wood at the other end to ram home the Powder and the Waddings. **Waddings** is Okum, old Cleats, or Straw, put after the Powder and the Bullet. A **Case** is made of two Pieces of hollow wood joyned together like two half Cartrages fit to put in-

How to find it.

Bitchings.

Chambers.

Cartrage,

Cases.

A Budge-barrel.

A Ladle.

A Spunge.

A Rammer.
Waddings:

Wood-cases.

to the Bore of a Piece, and a **Cafe-shot** is any kind of small Bullets, Nails, old Iron, or the like to put into the Cafe to shoot out of the Ordnance or Murderers, these will do much mischief when we lie board and board: but for Spunges and Rammers they use now a stiff Rope a little more than the length of the Piece, which you may turn and wind within board as you will, with much more ease and safety than the other.

Round-shot is a round Bullet for any Piece: **Cross-bar-shot** is also a Round-shot, but it hath a long spike of Iron cast with it, as if it did go through the midst of it, the ends whereof are commonly armed for fear of burbling the Piece, which is to bind a little **Okum** in a little Canvas at the end of each Pike. **Trundle-shot** is only a bolt of Iron sixteen or eighteen Inches in length; at both ends sharp pointed, and about a handful from each end a round broad bowl of lead according to the Bore of the Piece cast upon it. **Langrel-shot** runs loose with a Shackel, to be shortened when you put it into the Piece, and when it flies out it doth spread itself, it hath at the end of either Bar a half Bullet either of Lead or Iron. **Chain-shot** is two Bullets with a Chain betwixt them, and some are contrived round as in a Ball, yet will spread in flying their full length in breadth; all these are used when you are near a Ship to shoot down Masts, Yards, Shrouds, tear the Sails, spoil the men, or any thing that is above the Decks. **Fire-works** are divers, and of many Compositions, as **Arrows** trimmed with Wild-fire to stick in the Sails or Ships-side, shot burning. **Pikes** of Wild-fire to strike burning into a Ship-side to fire her. There is also divers sorts of **Granadoes**, some to break and fly in abundance of pieces every way, as will your **Brass-balls**, and Earthen-pots, which when they are covered with Quartered Bullets stuck in Pitch, and the Pots filled with good Powder, in a crowd of people will make an incredible slaughter; some will burn under water, and never extinguish till the stuff be consumed; some only will burn and fumè out a most stinking poyson smoke; some, being but only an Oil, being anoin-

Round-shot.
Cross-bar-shot.
To arm a shot.

Trundle-shot.

Langrel-shot.

Chain-shot.

Fire-works.
Arrows of Wild-fire.
Pikes of Wild-fire.
Granadoes of divers sorts.
Brass-Balls.

anointed on any thing made of dry wood, will take fire by the heat of the Sun when the Sun shines hot. There is also a Powder, which being laid in like manner upon any thing subject to burn, will take fire if either any rain or water light upon it; but those inventions are bad on shore, but much worse at Sea, and are naught because so dangerous, and not easy to be quenched, and their practice worse, because they may do as much mischief to a friend as to an enemy, therefore I will leave them as they are.

There are also divers sorts of **Powder**, the **Serpentine** is like dust and weak, and will not keep at Sea but be moist. The common sort is great corned Powder but gross, and only used in great Ordnance. Your fine corned Powder for hand Guns is in goodness as your Salt-peter is often refined, and from ten pence a pound to eighteen pence a Pound.

A **Tomkin** is a round piece of wood put into the Pieces mouth and covered with Tallow, and a **Fid**, or Fuse, a little **Okum** made like a Nail put in at the Touch-hole, and covered with a thin Lead bound above it to keep the Powder dry in the Piece. **Shackels** are a kind of Rings but not round, made like them at the Hatches corners (by which we take them up and lay them down) but bigger, fixed to the midst of the Ports within board, through which we put a Billet to keep fast the Port from flying open in foul weather, which may easily endanger, if not sink the Ship. **To cloy or poyson a Piece**, is to drive a Nail into her Touch-hole, than you cannot give fire. And to **uncloy** her, is to put as much oyl as you can about the Nail to make it glib, and by a train give fire to her by her mouth, and so blow it out.

Compass Callipers belongs to the Gunner, and is like two half Circles that hath a handle and joint like a pair of Compasses, but they are blunt at the points to open as you please for to dispart a Piece. A **Bozne** is his Touch-box, his **Primer** is a small long piece of Iron, sharp at the small end to pierce the Carriage through the Touch-hole. His **Lint stock** is a handsome carved stick, more than half a yard long,

Powder.
Serpentine-powder.
Gross corned Powder.
Fine corned Powder.

A Tomkin.
A Fid.

Shackels:

To cloy a Piece or poyson her.
To uncloy.

Compass-Callipers.

Horne.
Priming Iron.
Lint-stock.

Gunnerys Quadrant.
Dark Lanthorn.
Mortars.
The names of small Pieces, and their Implements.
Bandiliers.
Bullet-bags.
Worms.
Scowlers.
Melting-Ladles.
Lead-Molds.
Quartered shot,

long, with a Cock at the one end to hold fast his Match, and a sharp Pike in the other to stick it fast upon the Deck or Platform upright. The Gunners Quadrant is to level a Piece, or mount her to any random. A dark Lanthorne is as well to be used by any body as he. For Mortars, or such Chambers as are only used for Triumphs, there is no use for them in the service: but for Curriours, Harquebuses, Muskets, Bastard-muskets, Colivers, Crabuts, Carbins, long Pistols, or short Pistols, there belong to them Bandiliers, Bullet-bags, Worms, Scowlers, melting-Ladles, Lead, Molds of all sorts to cast their shot. Quarter Bullets is but any Bullet quartered in four or eight parts, and all those are as useful a Shipboard as on shore. For the Soul, Trunk, Bore, Fortification, the diversity of their Metals, and divers other curious Theorems or terms used about great Ordnance, there are so many uncertainties as well in her Mounting, Levelling upon her Platform, as also the accidents that may happen in the Powder, the ground, the air, and differences in proportion, I will not undertake to prescribe any certain Artificial Rule. These proportions following are near the matter, but for your better satisfaction read Master Digs's *Pantometria*, Master Smith, or Master Bourn's *Art of Gunnery*, or Master Robert Norton's *Exposition upon Master Digs's Stratiatico's*, Nicholas Tartalia, any of those will shew the Theory at large. But to be a good Gunner you must learn it by practice.

CHAP. II.

How a Gunner ought to be Qualified.

Supposing him to be a Christian fearing and serving the true God; and living in good repute and esteem among men. He ought (besides this) to be competently experienced in several Arts and Sciences; and especially in these following.

1. In

1. In *Arithmetick* both *Vulgar* and *Decimal*; whereby he may be able to work the *Rule of Three* (or *Golden Rule*) both *Direct* and *Reverse*, to *Extract* the *Square* and *Cube-Roots*, &c.

2. In *Geometry*, whereby he may be able to take *Heights*, *Depths*, and *Distances*; To take the true *Plat* of any *Piece of Ground*; and thereby to *Mine* or *Counter-mine* under the same, or any part thereof.

3. He ought to be Experienced in making of *Ramparts*, *Cannon*, *Baskets of Earth*, and *Fire works*, both for *Service* and *Recreation*.

4. He ought to be acquainted with the *Names* of every member of which a *Piece of Ordnance* is composed, and to what use every member is appropriated.

5. He ought to know how to search and pry into the conditions of any *Gun* or *Guns* committed to his charge: As to know whether *truly bored*, or *taper bored*; whether with or without a *Chamber*; whether free from *flaws* (or *Honey-combs*.) To know what quantity of *Powder* will serve for a due *Charge* for each *Piece*, what *Shot* will fit; how many *Matrosses* to attend; how many *Horses* or *Oxen* will serve to draw any *Piece*, or (in case they cannot be had) how many *men* may serve.

CHAP. III.

Of such Necessary Implements and Instruments as a Gunner that hath charge of Guns or Artillery ought to be furnished with.

Carriages, Wheels, Axletrees, Ladles, Rammers, Sheepskins to make *Spunges*; *Gun Powder*, *Shot*, (*Plain* and *Cross Bar*, and also *Chain shot*), *Canvas* and *Strong Paper* to make *Cartrages*, *Fire works*, *Hand-Spikes*, to mount and dismount *Pieces*;

Pieces; a *Dark Lanthorn*, and *Budge-Barrels* to carry *Powder*, *Sticks*, *Match*, *Wedges*, *Tomkings*, *Priming-Irons*, &c.

Also he ought to be furnished with these necessary *Instruments*: (1) A *Gunner's Height-Rule* of *Wood*, or *Brass*, or *Brass-circles*, and a *Pair* or two of *Compasses*, one *Pair* with three *Points* to draw with *Black Lead* and *Ink*; and one plain *Pair*; and also a *Pair* of *Callopers*, to take the *Diameter* of any *Ring* or *Bullet*. (2) A *Gunner's Quadrant* to *level*, *elevate*, or *depress* his *Gun*; and *Engines* to try the *strength* of *Powder*, &c.

CHAP. IV.

Cautions that a Gunner ought to observe before he fire his Gun.

1. **T**HAT in breaking up the *Head* of his *Powder-Barrels*, he use a *Wooden Mallet* with his *Iron Tool*, and not a *Hammer*, for fear of firing.

2. That he give his *Gun* its due *Charge* of *Powder*, and no more. And if by trial (before he put in his *Charge*) he find that his *Piece* is not truly *bored*, he must then proportion his *Charge* according to the *thinnest* side of the *Metal*, as shall be shewed in due place.

3. He is to consider that a *long Wad* of *Hay* or untwisted *Ropes*, will make the *Shot* shoot *wide* of the mark.

4. He ought to see the *Trunnions* are truly seated in the *Carriage*; whether one *Wheel* be higher, or reverse faster than the other; whether the *Platform* be *level* or not, and also free from *Stones* or other impediments to hinder the motion of the *Wheels*.

5. If the *Gun* he is to discharge, lie *point-blank*, or *under-Metal*, he ought to put in a sufficient *Wad* after the *Shot*, to keep it close to the *Powder*; for if the *shot* lie not close, the *Peece*

Peece will be subject to break in that vacancy. But if his *Piece* be mounted to any *Elevation*, he need not put a *Wad* after the *shot*.

CHAP. V.

Of Gunpowder, and how it hath been made from time to time, and how it is made at this present.

ANNO 1380 *Gunpowder* was made of *Saltpetre*, *Brimstone*, and *Charcoal*, of each a like quantity.

ANNO 1410 it was made of three parts *Saltpetre*, and two parts of *Brimstone* and *Charcole*.

ANNO 1480 it was made of *Saltpetre* eight parts, and of *Brimstone* and *Charcoal* each three parts.

ANNO 1520 it was made of *Saltpetre* four parts, and of *Brimstone* and *Charcoal* each one part.

Gunpowder, as it is made in this Age, is compounded of *Saltpetre* six parts, and of *Brimstone* and *Charcoal* of each one part.

Musket-powder is now made of *Saltpetre* five parts, one part of *Brimstone*, and one of *Coal*.

And *Cannon powder* of four times as much *Saltpetre*, as of *Coal* and *Brimstone*, agreeable to that was made ANNO 1520.

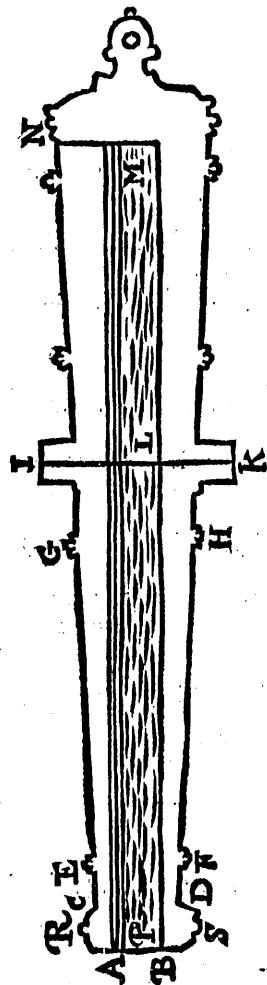
A pound of *Powder* as it is now made, (as it was experimented in five several sorts of *Powder* here, little differing from each other, but the large corned *Powder* was the heaviest) one pound will fill thirty one Cubical Inches, and six hundred parts of an Inch.

CHAP. VI.

Of the Names of the several parts or members of a Piece of Ordnance.

LET this Figure represent the *Ichnography* of any *Great Gun* or *Piece of Ordnance*: In which,

A B



A B is the Diameter of the Muzzle, the Concave Cylinder, or Bore of the Piece; and the Molding above that, noted with R S is the Muzzle Ring, or Cornice.

C is the Freeze.

C D the Neck.

E F the Astragal, or Cornice Ring.

G H the Reinforced Ring.

I K the two Trunnions.

L M the Chamber.

N the Base Ring, and the Touch-hole, marked out to fall just with the end of the Bore.

O the Cascabel, or Pummel.

P L the Vacant Cylinder from the Charge or Chamber, for the guide of the Shot.

M O the Breech.

M N. the thickness of Metal at the Breech.

R is the Dispart, which is a piece of a small stick or Wyre, set perpendicularly upon the Muzzle-Ring of any Gun, of such length that the top of it may be equal (in height) to the upper part of the Base Ring.

CHAP.

CHAP. VII.

Of the several Pieces of Ordnance now in Use.

BEfore I proceed to the practice of this Art of Gunnery, I shall give you a brief View of the Names of the several Pieces of Ordnance now in Use in this Nation, as also of four other Pieces used in Holland, and other parts of the Low-Countries; all which the following Table will exprefs at one view.

The Table Explained.

The Table consisteth of nine Rows or Columes:

- In the
- First, Is the Names of all Ordnance now in use.
 - Second, Is the Diameter at the Bore, in Inches and 100 parts of an Inch.
 - Third, Is the Weight of the Peece in Pounds.
 - Fourth, Is the Length of the Peece in Feet, and 100 parts of a Foot.
 - Fifth, Is the Quantity of Powder which will Load the Piece, in Pounds and 100 parts of a Pound.
 - Sixth, Is the Diameter of the Shot for the Peece, in Inches and hundred part of an Inch.
 - Seventh, Is the Shot-weights, in Pounds and hundred parts of a Pound.
 - Eighth, Is the Length of the Spoon of the Ladle in Inches and 100 parts.
 - Ninth, Is the breadth of the Plate of the Ladle.

First, And here note, That in this Table, the Ladle is but 3 Diameters of the Shot in length, and three fifth parts of the Circumference.

Secondly, The Charge of Powder from the Cannon to the whole

A Table wherein is described the Names of all sorts of Ordnance, from the Cannon to the Bafe; Also the Lengths, Breadths, Weights, Diameters, &c. of Powder, Shot, Ladle, &c. belonging to each Piece.

The Names of the several Pieces of Ordnance now in Use.	Diameter at the Bore		Weight	Long	The Load	Shots Diameter	Weight of Shot	Length of Ladle	Breadth of Ladle
	Inch 100 parts	part	pound weight	ft 100 parts	pound 100 parts	inch 100 parts	pound 100 parts	inch 100 parts	inch 100 parts
Cannon.	8.00		8000	12.00	22.50	7.50	58.00	24.00	14.75
Demi Cannon, Extra.	6.75		6000	12.00	18.00	6.62	36.00	22.75	12.00
Demi Cannon, Ordi.	6.50		5600	12.00	17.50	6.16	32.00	22.00	12.00
Culvering, Extraordinary	5.50		4800	12.00	12.50	5.25	20.00	16.00	10.00
Culvering, Ordinary	5.25		4500	12.00	11.37	5.00	17.31	15.00	9.50
Culvering of the least size	5.00		4000	12.00	10.00	4.75	14.90	14.25	9.00
Demi Culvering, Extraordinary	4.75		3000	12.00	8.50	4.50	12.69	13.50	8.50
Demi-Culvering Ordinary	4.50		2700	10.00	7.25	4.25	10.26	12.75	8.00
Demi-Culvering of the lesser size	4.25		2000	9.00	6.25	4.00	9.00	12.00	8.00
Saker, Extraordinary	4.00		1800	9.00	5.00	3.75	7.31	11.00	7.25
Saker, Ordinary	3.75		1500	9.00	4.00	3.50	6.00	10.50	6.75
Saker of the least size	3.50		1400	8.00	3.25	3.25	4.75	9.75	6.50
Minnion, Large	3.25		1000	8.00	3.25	3.00	3.75	9.00	5.00
Minnion, Ordinary	3.00		750	7.00	2.50	2.92	3.25	8.50	5.00
Falcon	2.75		750	7.00	2.25	2.58	2.50	8.25	4.50
Falconet	2.25		400	6.00	1.25	2.01	1.31	7.50	4.00
Rabonet	1.50		200	5.50	0.75	1.28	0.50	4.25	2.50
Bale	1.25		200	4.50	0.50	1.12	0.50	4.00	2.00

whole

whole Culvering is allowed to be about two Diameters of the Bore of the Piece. The Charge from the Culvering to the Minion, two Diameters and a half. And from the Minion to the Bafe, three Diameters.

C H A P. VIII.

How to find the Diameter of any Round Shot or Bullet, by knowing the Circumference: Or, By having the Circumference of a Shot, to find the Diameter.

I. Mechanically.

Get the Shot about with a Tape, or piece of narrow Ribband; then divide the length of that Line or Girt into 22 equal parts, and 7 of those parts shall be the Diameter: So, if a Shot be 37 Inches about, the Diameter will be found to be 17 Inches 3 quarters, and somewhat more:

But if the Diameter were given, and the Circumference were required: Then divide the Diameter into 7 equal parts, and three times the Diameter, and one of the seven parts added to it, shall be equal to the Circumference: These ways are troublesome, wherefore another way to find the Diameter of any Round Shot, or the Ring of a Gun, is by a pair of Galloper Compasses, which are Compasses bowed at the Points, I need not describe them, they are known well enough; but this work may be performed by the following Table for finding the length of a Dispart, and the Diameter or Circumference of any Ring of a Gun or Shot, &c.

1. The Circumference of any Ring or Bullet, given to find the Diameter.

Find the Circumference of the Ring or Bullet in Inches and tenths of Inches in the first Column and head of the Table, and against the Inches in the first Column, and under the tenths

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CHAP. IX.

A TABLE shewing how to find the Diameter of any Circle or Ring of a Gun not exceeding 54 Inches : Of excellent use for the ease and exact finding of the length of the Dispart of any Gun : As also of the Diameter of any Shot or Bullet : without Callopers, and also of Granada-Shells.

Tenth Parts of Inches.

Inches.	0	1	2	3	4	5	6	7	8	9
0	0.00	0.03	0.06	0.09	0.13	0.16	0.19	0.22	0.25	0.29
1	0.32	0.35	0.38	0.41	0.44	0.48	0.51	0.54	0.57	0.60
2	0.64	0.67	0.70	0.73	0.76	0.80	0.83	0.85	0.89	0.92
3	0.95	0.98	0.91	1.05	1.08	1.11	1.15	1.18	1.21	1.24
4	1.27	1.30	1.34	1.37	1.40	1.43	1.46	1.50	1.53	1.56
5	1.59	1.62	1.65	1.68	1.72	1.75	1.78	1.81	1.85	1.88
6	1.91	1.94	1.97	2.00	2.03	2.07	2.10	2.13	2.16	2.19
7	2.23	2.26	2.29	2.32	2.36	2.39	2.42	2.45	2.48	2.51
8	2.55	2.58	2.61	2.64	2.67	2.71	2.74	2.77	2.80	2.83
9	2.86	2.90	2.93	2.96	3.00	3.02	3.06	3.09	3.12	3.15
10	3.18	3.21	3.25	3.28	3.31	3.34	3.37	3.41	3.44	3.47
11	3.50	3.53	3.56	3.60	3.63	3.66	3.69	3.72	3.75	3.79
12	3.82	3.85	3.88	3.91	3.95	3.98	4.01	4.04	4.07	4.11
13	4.14	4.17	4.20	4.23	4.26	4.30	4.33	4.36	4.39	4.42
14	4.46	4.49	4.52	4.55	4.58	4.62	4.65	4.68	4.71	4.74
15	4.77	4.80	4.83	4.87	4.90	4.93	4.97	5.00	5.03	5.06
16	5.09	5.12	5.16	5.19	5.22	5.25	5.28	5.31	5.34	5.37
17	5.41	5.44	5.47	5.51	5.54	5.57	5.60	5.63	5.67	5.70
18	5.73	5.76	5.79	5.82	5.86	5.89	5.92	5.95	5.98	6.01
19	6.05	6.08	6.11	6.14	6.17	6.21	6.24	6.27	6.30	6.33
20	6.37	6.39	6.43	6.46	6.49	6.52	6.56	6.59	6.62	6.65

Tenth

Tenth parts of Inches.

Inches.	0	1	2	3	4	5	6	7	8	9
21	6.68	6.72	6.75	6.78	6.81	6.84	6.88	6.91	6.94	6.97
22	7.00	7.03	7.07	7.10	7.13	7.16	7.19	7.22	7.26	7.29
23	7.37	7.39	7.38	7.42	7.45	7.48	7.51	7.54	7.58	7.61
24	7.64	7.67	7.70	7.73	7.77	7.80	7.83	7.86	7.89	7.93
25	7.96	7.99	8.02	8.05	8.08	8.12	8.15	8.18	8.21	8.24
26	8.28	8.31	8.34	8.37	8.40	8.43	8.47	8.50	8.53	8.56
27	8.59	8.63	8.66	8.69	8.72	8.75	8.79	8.81	8.85	8.88
28	8.91	8.94	8.98	9.00	9.04	9.07	9.10	9.13	9.17	9.20
29	9.23	9.26	9.29	9.33	9.36	9.39	9.42	9.45	9.49	9.52
30	9.55	9.58	9.61	9.65	9.68	9.71	9.74	9.77	9.80	9.84
31	9.87	9.90	9.93	9.96	10.00	10.03	10.06	10.09	10.12	10.15
32	10.18	10.22	10.25	10.29	10.31	10.34	10.38	10.41	10.44	10.47
33	10.51	10.54	10.57	10.60	10.63	10.66	10.70	10.73	10.76	10.79
34	10.82	10.85	10.89	10.92	10.95	10.98	11.01	11.04	11.07	11.11
35	11.14	11.17	11.20	11.24	11.27	11.30	11.33	11.36	11.39	11.43
36	11.46	11.49	11.52	11.55	11.59	11.62	11.65	11.68	11.71	11.75
37	11.78	11.81	11.84	11.87	11.90	11.94	11.97	12.00	12.03	12.06
38	12.10	12.13	12.16	12.19	12.22	12.25	12.28	12.32	12.35	12.38
39	12.41	12.45	12.48	12.51	12.54	12.57	12.60	12.64	12.67	12.70
40	12.73	12.76	12.79	12.83	12.86	12.89	12.92	12.95	12.98	13.02
41	13.05	13.08	13.15	13.18	13.21	13.24	13.27	13.30	13.33	13.37
42	13.37	13.40	13.43	13.46	13.50	13.53	13.56	13.59	13.62	13.65
43	13.69	13.72	13.75	13.78	13.81	13.85	13.88	13.91	13.94	13.97
44	14.00	14.03	14.07	14.10	14.13	14.16	14.20	14.23	14.26	14.29
45	14.33	14.36	14.39	14.42	14.45	14.48	14.51	14.55	14.58	14.61
46	14.64	14.67	14.70	14.74	14.76	14.80	14.83	14.86	14.90	14.93
47	14.96	14.99	15.02	15.06	15.09	15.12	15.15	15.18	15.21	15.25
48	15.28	15.31	15.34	15.37	15.40	15.44	15.47	15.50	15.53	15.56
49	15.60	15.62	15.66	15.69	15.72	15.76	15.79	15.82	15.85	15.88
50	15.92	15.95	15.98	16.01	16.04	16.07	16.11	16.14	16.17	16.20
51	16.24	16.27	16.30	16.33	16.36	16.40	16.43	16.46	16.49	16.52
52	16.55	16.58	16.62	16.65	16.68	16.71	16.74	16.77	16.80	16.83
53	16.87	16.90	16.93	16.97	16.99	17.03	17.06	17.09	17.12	17.15

The Circumference of the Ring or Bullet in Inches.

The Description of the Table.

The *Table* is Calculated from one tenth part of an Inch *Circumference*, to 54 Inches *Circumference*, which is large enough for the *Girt* of the *Base Ring* of any *Gun* : Or for the *Circumference* of any *Bullet* or *Granado Shell* ; for which purposes this *Table* will be serviceable, as shall be shewed hereafter.

The *Table* consisting of *Eleven Columns*, the first *Column* of the *Table* (beginning at 0 Inches, and ending at 53 Inches) shews the number of whole *Inches* that any *Ring* of a *Piece*, or *Girt* of a *Bullet* is in *Circumference*. The nine Figures at the *Heads* of the *Table*; which are 0, 1, 2, 3, &c. (and are larger than the rest) signifie tenth parts of Inches of the *Circumference* of any *Ring* or *Bullet*. And the Figures in the other *Columns* are the *Diameters* of *Circles*, the *Girt* of whose *Circumference* are found in the *Side* and *Head* thereof.

The Use of the Table.

The *Uses* of this *Table* are principally two, *First*, by having the *Circumference* of any *Circle* given, to find the *Diameter* ; or, *Secondly*, having the *Diameter*, to find the *Circumference*.

Example 1. If the *Circumference* of a *Circle* be 18 Inches, and three tenth parts of an Inch, how much is the *Diameter* of that *Circle* ?

Find 18 Inches in the first *Column* of the *Table*, and three tenths at the top of the *Table* ; and right against 18, and under 3, you shall find 5.82, that is 5 Inches, and 82 hundred parts of an Inch, for the length of the *Diameter* of that *Circle*.

Example 2. If the *Diameter* of a *Circle* be 13 Inches and 75 hundred parts of an Inch, how much is the *Circumference* of that *Circle* ?

Look

Look for 13. 75 among the Figures in some of the *Columns* of the *Table*, which number you will find to stand under the figure 2 in the head of the *Table*, and against 43 in the first *Column* of the *Table*, which shews the *Circumference* of that *Circle* to be 43 Inches, and two tenth parts of an Inch.

C H A P. X:

Concerning the Disparting of any Piece of Ordnance, and how to find the length of the Dispart.

THE *Dispart* of a *Piece*, is the difference between the thickness of the *Metal* at the *Muzzle* and *Breech* of the *Piece* : And to find it there are several ways.

I. Mechanically.

Take your *Priming Iron*, and put it down right in the *Touch-hole*, till it touch the *Metal* at the bottom of the *Bore*, and upon the *Iron* make a mark level with the top of the *Base Ring* of the *Piece* : Then apply the *Priming-Iron* to the bottom of the *Metal* at the *Mouth* of the *Piece* ; and upon it make another mark, equal with the top of the *Muzzle Ring* of the *Piece* ; so shall the distance between these two Marks, be the true length of the *Dispart* proper for that *Gun*.

Another way not much differing from the former may be thus :

Take a small *Stick* or *Straw* that is strait, and put it into the *Touch hole* to the lower part of the *Cylinder* (or *Concave*) of the *Gun*, and cut it off close to the *Metal* at the top of the *Base Ring* of the *Piece* ; then apply it in the same manner to the *Mouth* of the *Piece*, and cut it off level with the top of the *Muzzle Ring*, so shall the little piece cut off be the *Dispart* ; which being set upright upon the top of the *Muzzle*

zle Ring of the Piece with Clay, Pitch or Wax, it shall be the true *Dispart*.

There are other Mechanick ways to perform this Work, but the best of them are uncertain; wherefore I shall shew how it may be performed other ways.

II. By the foregoing Table.

Let the Girt of the Base Ring of a Piece be 42 Inches, and the Girt of the Muzzle Ring 31 Inches; and let the length of the *Dispart* for such a Piece be required.

Look in the first Column of the Table for 42 (the Girt of the Base Ring) and against it (in the next Column) is 13. 37. that is 13 Inches and 37 hundred parts of an Inch; for the Diameter of the Base Ring. Again, look in the first Column of the Table for 31. (the Girt of the Muzzle Ring, and against it (in the next Column) is 9. 87. that is, 9 Inches and 87 hundred parts of an Inch, for the Diameter of the Muzzle Ring as before; the difference between these is, 3. 50. which is 3 Inches and a half; the half whereof is, 1. 75 (or 1 Inch and 3 quarters) for the length of the *Dispart* of such a Gun.

Another Example :

Let the Girt or Circumference of the Base Ring of a Gun be 37 Inches, and 4 tenth parts of an Inch : And let the Girt of the Muzzle Ring of the same Piece be 26 Inches and 6 tenths of an Inch : I would know the length of the *Dispart* for such a Gun.

Look in the first Column of this Table for 37 Inches, and among the great figures at the head, for 4 (which is the 4 tenths of an Inch) And then against 37 in the first Column, and under 4 at the top, you shall find 11. 90, which is 11 Inches, and 90 hundred parts of an Inch (or 9 tenths of an Inch) for the Diameter of the Base Ring of the Piece. Again, look in the Table for 26 Inches in the first Column, and for 6 at the head of the Table, and right against 26 in the first Column, and under 6 at the head, you shall find this number 8. 47, which is 8 Inches

Inches 47 hundred parts of an Inch : Subtract 8. 47 from 11. 90, the remainder will be 2. 57, the half whereof is 1. 28, that is 1 Inch, and 28 hundred parts of an Inch, for the true length of the *Dispart* of that Gun.

A Third Example :

	Diameter.
Girt of the Base Ring, 47 Inch. 3 tenths ———	15. 06
Girt of the Muzzle Ring 32 Inch. 5 tenths ———	10. 34
Their Difference	4. 72
The half 2 In. 36 hund. parts of an Inch, the <i>Dispart</i>	2. 36

And let this suffice for the use of this Table in this place.

All these ways here prescribed for *Disparting* of a Piece, do suppose the Piece to be truly bored; but if it be Chamber bored, observe what followeth.

How to know whether a Piece be Chamber bored, or not.

First, find the *Dispart* of the Piece, by the Priming-Iron or a Stick, also find it by the Table; and if you find them two ways to agree, take that for the true *Dispart*. Take the *Dispart* by the third way, but if the *Dispart* taken by the several ways differ, then that difference is the just difference of the Chamber from the true Bore of the Piece.

As for Example :

Suppose the *Dispart* found by the Priming Iron to be two Inches, and by the Table 3 Inches; it shews that the Chamber differs from the true Bore, on each side one Inch; so that if the Bore of the Piece be six Inches high, the Chamber is but 4 Inches high.

This the Gunner ought to examine and enquire into, that he may make his Cartridges to load his Piece withal accordingly.

C H A P. XI.

How to know whether a Piece of Ordnance be truly bored or not, when it is in its Carriage: and lying Horizontally.

Provide a *Pike-staff*, which let be about one foot longer than the Bore of the Piece from the Touch-hole; and at the end thereof, fasten a Rammer head, that will justly fill all the Bore under the Touch-hole; and at the other end of the Staff, bore a hole big enough to put through a Rod of Iron about 16 or 18 Inches long, and at the end of the Rod hang a *Bullet* or *Weight* of about 7 or 8 pound; for this Weight thus disposed will cause the same part of the *Rammer-head* to lye always with the same part uppermost. Put this Instrument thus prepared into the *Piece*, letting the *Iron Rod* and *Bullet* hang perpendicularly; then putting your *Priming-Iron* in at the Touch-hole, make a mark upon the *Rammer-head*: This done, draw your *Instrument* out of the *Gun*, and lay it upon a long *Form* or *Table*, letting the *Rod* and *Bullet* hang over the end of the *Table* as it did before out of the mouth of the *Piece*. Then observe, whether the mark you made upon the head of the *Rammer* when it was in the *Piece*, be just on the uppermost part of the same when it lyeth upon the *Table*; and if it be, the *Bore* of the *Piece* lyeth neither to the right or left hand: But if you find it to lie half or a quarter of an Inch either to the right or left hand, so much lyeth the *Bore* either to the right or left, and the *Piece* in shooting must be ordered and charged accordingly.

By what is here said, may be found whether the *Piece* incline towards the *Right* or *Left* hand, but to know whether it lie also upwards or downwards, and not in the middle: Then,

to

to find which way; Take the *Diameter* of the *Piece* at the *Touch-hole*, as is before taught: Then take a piece of *Wyre*, and bend it a little at the end that it may catch at the *Mettal* when it is drawing out at the *Touch-hole*. This *Wyre* thus prepared, put it in at the *Touch-hole*, till it touch the bottom of the *Metal* in the *Chamber*, and holding it there, make a mark upon it, just even with the *Touch-hole*; then pull up the *Wyre* till it catch at the *Metal* on the top of the *Chamber*, and make another mark upon it, the distance between these two marks, is the just *Diameter* of the *Chamber*: And the distance between the first mark, and the end of the *Wyre* (half the *Diameter* of the *Chamber* of the *Piece* being subtracted) will leave half the *Diameter* of the *Piece*, if the *Piece* be truly Bored: But if this number be more than half the *Diameter* of the *Piece*, before found, at the *Touch-hole*; than the *Bore* lyeth too far from the *Touch-hole*, and the upper part of the *Metal* is the thickest: but if lesser, then the under part of the *Piece* hath the most *Metal*.

Example: Suppose I find the *Diameter* of my *Gun* to be at the *Touch-hole* 12 Inches; then with my *Wyre*, I find the *Diameter* of the *Bore* to be 4 Inches; and to the bottom of the *Metal* it is 7 Inches and an half; now half the *Diameter* of the *Bore* being 2 Inches, that added to the second mark upon the *Wyre*, or subtracted from 7 Inches and a half, the first Mark, leaves 5 Inches and a half, which is less than half the *Diameter* of the *Gun* at the *Touch-hole* first found, by half an Inch; and therefore the greatest part of the *Metal* is under the *Bore* of the *Piece*, and the *Gun* likeliest to break above.

And here note: If you were to make a *Dispart* for such a *Gun* as this, you are to make it half an Inch shorter then it will be found to be by taking the *Circumference*, and finding the *Diameters* of the *Rings* at the *Base* and *Muzzle*: And the like is to be observed if the difference were greater, or the upper part of the *Metal* had been greater.

C H A P. XII.

Concerning Guns that are not truly bored; How to know what quantity of Powder must be allowed for their Loading.

Suppose the Diameter of the Metal of a Piece at the Touch-hole, be 16 Inches, and the Diameter at the Bore 5 Inches and a quarter, the Weight of the Piece 4850 pound: Now such a Piece will require 11 pound of Powder for its Loading: But I find the Bore to be an Inch out of its place, thence I conclude the thinnest part of the Metal is 4 Inches and half a quarter, and the thickest side 6 Inches and half a quarter, by which it appears, that one side is two Inches thicker than the other.

Now to find what quantity of Powder will be a sufficient Load for such a Piece, it must be computed from the thinnest part of the Metal, which is here 4.375 Inches, which doubled is 8.75 Inches, to which add the Diameter at the Bore 5.25 Inches, the sum is 14.00 Inches, which call the lesser Diameter, and 16 the greater Diameter: And to find the quantity of Powder by Arithmetick, this is the Proportion:

As the Cube of 16 (the greater Diameter) 4096,
Is to the Cube of 14 (the lesser Diameter) 2744;

So is 11 pound (the Powder to be allowed if the Piece had been truly Bored)

To 7.36 pound (the Powder to be allowed to the false Bored Piece.)

For, multiply 16 by 16, it produceth 256, and that again by 16, and it produceth 4096, which is the Cube of 16 the Greater Diameter.

Also, multiply 14 by 14, it produceth 196, and that again by

by 14, produceth 2744, which is the Cube of 14, the Lesser Diameter.

Then Multiply 2744 (the Cube of the Lesser Diameter) by 11 (the Powder to be allowed, if the Piece had been truly bored) the product will be 30184: which number divided by 4096 (the Cube of the Greater Diameter) gives in the Quotient 7.36 pounds of Powder, which will be a sufficient Charge for such a false bored Gun.

C H A P. XIII.

How to discover what Cracks, Flaws, or Honeycombs are in any Piece of Ordnance.

As soon as ever you have discharged any Piece of Ordnance, let one be ready to cover the Mouth of the Piece close, and stop the Touch-hole at the same time; by which means you may know if any Cracks or Flaws do go through the Metal, for if any such be, a visible smoke will come through those Flaws or Cracks.

Otherwise: In a clear Sun shine day, with a piece of polished Steel (or plain Looking-Glass) reflect the Beams of the Sun into the hollow Cylinder of the Piece, so shall you have a clear shining light within the concave of the Piece, by which you may see all Flaws, Cracks, or Honeycombs.

And in case the Sun do not shine, get a Stick somewhat longer than the hollow of the Piece, and cut a notch at one end thereof, wherein to put a piece of a Candle; put this Stick with the Candle lighted into the Piece, by whose light observe (as well as you can) whether from one end to the other you can discover any Flaws, &c. in the Piece.

Lastly, If upon the outside of the Metal of any Piece of Ordnance, you strike a smart blow with an Iron Hammer; If you then hear a hoarse sound, doubtless there are Honeycombs,

combs, or such like *Flaws*: But if at any stroke you hear a clear sound, you may conclude that Piece to be *sound*, and free from *Cracks*, &c.

C H A P. XIV.

Concerning the Weight of Iron-shot, and Granado-shells.

Having the Diameter of any Cast Iron Shot, you may find the Weight thereof.

FOR, it hath been generally agreed upon, that a *Cast Iron-Bullet* of 4 Inches Diameter will weigh 9 Pound, and so make that a proportion for all other Diameters: If so, then

As the *Cube* of 4 Inches, which is 64.

Is to 9 pound weight:

So is the *Cube* of any other Diameter, suppose 5 Inches (*viz.* 125.)

To 17.58 pound for the weight,
Which is 17 pound and a half and somewhat more.

Another way to perform the same somewhat easier.

This way is done by Multiplication only, and so somewhat easier than the former, and it is a way which was discovered by Mr. Valentine Pyne, late *Fire-Master* of England; and for the effecting of it, this is the *RULE*:

Cube the Diameter of the Bullet given, then Multiply that Cube number by 14, and cut off two Figures to the right hand, the Figures to the left hand are pounds weight, and the other two hundred parts of a Pound.

Example I. *Let it be required to find the Weight of a Cast Iron Bullet, whose Diameter is five Inches, the same as in the other Example.* The

The *Cube* of 5 Inches is 125, which multiplied by 14, produceth 1750, from which cut off the two figures towards the right hand, and it will be 17.50, that is 17 pound, and 50 hundred parts of a pound, which is just 17 pound and a half; and that is the weight required.

And this way (as he found it by often experience) comes nearer to the truth than the former, of 2 Pound to 4 Inches Diameter.

Example 2. *Let the Diameter of a Shot be 6 Inches and seven Tenths of an Inch; and let the Weight thereof be required.*

Multiply 6.7 by 6.7, the Product will be 44.89 for the *Square*, and that multiplied again by 6.7 produceth 300.863 for the *Cube* of the Diameter of the Shot. Which 300.863 multiplied by 14, produceth 4212.082, from which five figures to the right hand being cut off (that is three for the Decimal parts in the *Multiplicand* 300.863, and two, according as the *Rule directs*) the Remainder will be 42.12082, that is 42 Pound, and 12 hundred parts of a Pound for the Weight of the Shot whose Diameter is 6 Inches and 7 tenths of an Inch.

According to this Rule is the following *Table* made, which sheweth the weight of any *Iron Shot*, whose Diameter is given in Inches and Tenth parts of Inches; from one Inch to 20 Inches Diameter: in Pounds and 100 parts of a Pound weight.

The Use of the following Table.

Example 1. *Let the Diameter of an Iron-shot be 13 Inches, what is its weight?*

Look for 13 in the first Column of the Table towards the left hand, and against it in the next Column stands 307.58, which shews that such a Shot of Iron will weigh 307 Pound, and 58 hundred parts of a Pound, which is above half a Pound.

Exam. 2. *If a Cast-Bullet of Iron be in Diameter 11 Inches and 3 Tenths of an Inch, How much doth that Bullet weigh?*

Look

combs, or such like *Flaws*: But if at any stroke you hear a clear sound, you may conclude that Piece to be *sound*, and free from *Cracks*, &c.

CHAP. XIV.

Concerning the Weight of Iron-shot, and Granado-shells.

Having the Diameter of any Cast Iron-shot, you may find the Weight thereof.

FOR, it hath been generally agreed upon, that a Cast Iron-Bullet of 4 Inches Diameter will weigh 9 Pound, and so make that a proportion for all other Diameters: If so, then

As the Cube of 4 Inches, which is 64.

Is to 9 pound weight:

So is the Cube of any other Diameter, suppose 5 Inches (*viz.* 125.)

To 17.58 pound for the weight,

Which is 17 pound and a half and somewhat more.

Another way to perform the same somewhat easier.

This way is done by Multiplication only, and so somewhat easier than the former, and it is a way which was discovered by Mr. Valentine Pyno, late Fire-Master of England; and for the effecting of it, this is the *RULE*:

Cube the Diameter of the Bullet given, then Multiply that Cube number by 14, and cut off two Figures to the right hand, the Figures to the left hand are pounds weight, and the other two hundred parts of a Pound.

Example I. Let it be required to find the Weight of a Cast Iron Bullet, whose Diameter is five Inches, the same as in the other Example. The

The Cube of 5 Inches is 125, which multiplied by 14, produceth 1750, from which cut off the two figures towards the right hand, and it will be 17.50, that is 17 pound; and 50 hundred parts of a pound, which is just 17 pound and a half; and that is the weight required.

And this way (as he found it by often experience) comes nearer to the truth than the former, of 9 Pound to 4 Inches Diameter.

Example 2. Let the Diameter of a Shot be 6 Inches and seven Tenths of an Inch; and let the Weight thereof be required.

Multiply 6.7 by 6.7, the Product will be 44.89 for the Square, and that multiplied again by 6.7 produceth 300.863 for the Cube of the Diameter of the Shot. Which 300.863 multiplied by 14, produceth 4212.082, from which five figures to the right hand being cut off (that is three for the Decimal parts in the *Multiplicand* 300.863, and two, according as the *Rule direct*;) the Remainder will be 42.12082, that is 42 Pound, and 12 hundred parts of a Pound for the Weight of the Shot whose Diameter is 6 Inches and 7 tenths of an Inch.

According to this Rule is the following Table made, which sheweth the weight of any Iron Shot, whose Diameter is given in Inches and Tenth parts of Inches; from one Inch to 20 Inches Diameter: in Pounds and 100 parts of a Pound weight.

The Use of the following Table.

Example 1. Let the Diameter of an Iron-shot be 13 Inches, what is its weight?

Look for 13 in the first Column of the Table towards the left hand, and against it in the next Column stands 307.58, which shews that such a Shot of Iron will weigh 307 Pound, and 58 hundred parts of a Pound, which is above half a Pound.

Exam. 2. If a Cast-Bullet of Iron be in Diameter 11 Inches and 3 Tenths of an Inch, How much doth that Bullet weigh?

Look

Whole Inches in Diameter.									
1	2	3	4	5	6	7	8	9	10
0	0.14	0.19	0.27	0.31	0.38	0.47	0.57	0.69	0.82
1	0.19	0.27	0.31	0.38	0.47	0.57	0.69	0.82	0.96
2	0.27	0.31	0.38	0.47	0.57	0.69	0.82	0.96	1.12
3	0.31	0.38	0.47	0.57	0.69	0.82	0.96	1.12	1.30
4	0.38	0.47	0.57	0.69	0.82	0.96	1.12	1.30	1.50
5	0.47	0.57	0.69	0.82	0.96	1.12	1.30	1.50	1.72
6	0.57	0.69	0.82	0.96	1.12	1.30	1.50	1.72	1.96
7	0.69	0.82	0.96	1.12	1.30	1.50	1.72	1.96	2.22
8	0.82	0.96	1.12	1.30	1.50	1.72	1.96	2.22	2.50
9	0.96	1.12	1.30	1.50	1.72	1.96	2.22	2.50	2.80
10	1.12	1.30	1.50	1.72	1.96	2.22	2.50	2.80	3.12
11	1.30	1.50	1.72	1.96	2.22	2.50	2.80	3.12	3.46
12	1.50	1.72	1.96	2.22	2.50	2.80	3.12	3.46	3.82
13	1.72	1.96	2.22	2.50	2.80	3.12	3.46	3.82	4.20
14	1.96	2.22	2.50	2.80	3.12	3.46	3.82	4.20	4.60
15	2.22	2.50	2.80	3.12	3.46	3.82	4.20	4.60	5.02
16	2.50	2.80	3.12	3.46	3.82	4.20	4.60	5.02	5.46
17	2.80	3.12	3.46	3.82	4.20	4.60	5.02	5.46	5.92
18	3.12	3.46	3.82	4.20	4.60	5.02	5.46	5.92	6.40
19	3.46	3.82	4.20	4.60	5.02	5.46	5.92	6.40	6.90
20	3.82	4.20	4.60	5.02	5.46	5.92	6.40	6.90	7.42

The Tenths of Inches.

Look for 11 Inches in the first Column of the Table, and for 3 Tenths at the top of the Table, and right against 11, and under 3, you shall find 202.51, which is 202 Pound and an-half:

And so a Bullet being in Diameter 3.06 1/2 The Weight thereof will be found to be 123.96 3/4 336.86 712.37

Some other Uses of this Table.

THE Table is Calculated for 20 Inches Diameter of a Shot, or Bullet, but we have no Guns that carries a Bullet above 8 Inches, notwithstanding which, it was Calculated to 20 Inches, for finding the weight of Granado-Shells, which are also made of Cast-Iron; and the Diameter of those may from Out to Out be near 20 Inches, and therefore I shall instance in one of them.

Exam. 3. Let there be a Granado-Shell whose Diameter from Out to Out, let be 19 Inches 6 Tenths; and the Diameter within 15 Inches and 4 Tenths: What is the Weight of that Shell?

Look for 19 Inches in the first Column, and for 6 in the head of the Table, so against 19, and under 6 you shall find 1054. 1, Pound, which is the weight if it were a solid Shot; which number set down.

Then look in the first Column of the Table for 15 Inches in the first Column, and 4 in the head of the Table, and against 15 and under 4, you shall find 511. 32 Pound, which is the weight of a Shot of 15 Inches and 4 Tenths Diameter. Now if you subtract 511. 32 (the weight found by the Inner Diameter) from 1054. 40 (the Weight found by the Outer Diameter) the Remainder will be 543. 08 which is 543 Pound, for the Weight of the Shell.

The Diameter of the Shell without, may be found by its Circumference, as is before taught; or by a pair of Calloper Compasses:

passes: And for the *Diameter* within that may be found by putting in a Stick at the *Fuse-hole*, and measuring it by a Rule of Inches and Tenths: Or, (if the *Shell* be of equal thickness) by the thickness of the *Metal* at the *Fuse-hole*, which suppose to be 2 Inches and 1 Tenth; the double whereof is 4 Inches and 2 Tenths, and that taken from 19. 6, the Outer Diameter, leaves 15. 4 for the Inner Diameter.

19. 6
4. 2
—
15. 4

CHAP. XV.

Concerning the following Table of Cube-Roots.

THE following Table consisteth of two Columns, in the first of which towards the left hand is contained the *Roots* of all Numbers from 1 to 100, and of their *Halves* and *Quarters*.

So in the beginning of the Table, in the first Column you have 1. 0, that is, one *Inch*, one *Fathom*, one *Pound*, &c. and under 1. 0, you have 1, 2, 3, standing one under another, which is 1, 2, 3 *Quarters* of *Inches*, *Fathoms*, &c. and so on, from one *Inch* to 100.

In the second Column is the *Cubes* of all those Numbers which stand in the first Column: As against 2 in the first Column you shall find 8 in the second, which is the Cube of 2; for 2 multiplied by 2, produceth 4, and 4 multiplied again by 2 produceth 8, which is the Cube of 2. Also against 2 and 1 quarter, you shall find 11. 39 which is the Cube of 2 and a quarter: And thus may you find that:

Inch.	Quar.	Cube.
4	0	64
5	1	144. 90
6	2	274. 62
7	3	465. 48

In like manner, if the Cube of any Number be given, the Root thereof may be found.

So if 32768 were a *Cube-number* given, and the *Root* thereof were required:

Look in the second Column of the Table (which hath the word *Cube* at the head thereof) for this Number 32768, against which you shall find (under the word *Root*) 32, which is the *Root* thereof, for 32 multiplied by 32 produceth 1024, and that again multiplied by 32 produceth 32768, which is the *Cube* of 32. And thus may you find that,

Inch. Quar.
 $\left. \begin{array}{l} 103823 \\ 30275. 25 \\ 926. 49 \\ 34. 33 \end{array} \right\} \text{Is the Cube of}$
 $\left. \begin{array}{l} 47 \\ 14. 2 \\ 9. 3 \\ 3. 1 \end{array} \right\}$

The Use of the following Table of Cube-Roots, in the solution of several Questions, useful in the Art of Gunnery.

Quest. I. If a Bullet of Iron of six Inches Diameter weigh thirty Pound, what shall a Bullet of the same Metal weigh, whose Diameter is seven Inches.

Look in the Table for 6 in the first Column, against which you shall find 216, the Cube of 6: Also against 7 is 343 the Cube of 7. Then say by the Rule of Three:

As 16 (the Cube of 6 Inches.)

Is to 30 Pound, (the Weight of that Bullet):

So is 343 (the Cube of 7 Inches):

To 47. 64 (that is 47 Pound, and 64 hundred parts of a Pound) for the Weight of the Bullet of Iron, which is 7 Inches Diameter.

Multiply 343 by 30, the Product will be 10290, which divide by 216, the Quotient will be 47. 64 the Weight of the Shot required.

Quest. II. If the Diameter of a Shot be 3 Inches and 3 Quarters, and it do weigh 7 Pound 5 Ounces, (or in Decimals 7. 31) what will the Diameter of a Shot (of the same Metal) be whose Weight is 16 Pound?

The Cube of 3 Inches 3 Quarters is 52. 73; then by Proportion say,

Q 2

As

The Table of Cubes, and Cube-Roots to whole Inches, Halves and Quarters; or of any other Measure.

Root.	Cube	Root.	Cube	Root.	Cubes
1 0	1	8 0	512.	15 0	3375.
1 1	1. 95	1 1	561. 52	1 1	3546. 58
2 2	3. 37	2 2	614. 12	2 2	3723. 87
3 3	5. 36	3 3	669. 92	3 3	3906. 98
2 0	8	9 0	729.	16 0	4096.
1 1	11. 39	1 1	791. 45	1 1	4291. 02
2 2	15. 62	2 2	857. 37	2 2	4492. 12
3 3	20. 80	3 3	926. 86	3 3	4699. 42
3 0	27.	10 0	1000.	17 0	4913.
1 1	34. 35	1 1	1076. 89	1 1	5132. 95
2 2	42. 87	2 2	1157. 62	2 2	5359. 37
3 3	52. 73	3 3	1242. 30	3 3	5592. 36
4 0	64.	11 0	1331.	18 0	5832.
1 1	76. 76.	1 1	1423. 83	1 1	6078. 39
2 2	91. 12	2 2	1520. 87	2 2	6331. 62
3 3	107. 17	3 3	1622. 23	3 3	6591. 80
5 0	125.	12 0	1728.	19 0	6859.
1 1	144. 70	1 1	1838. 26	1 1	7133. 33
2 2	167. 37	2 2	1953. 12	2 2	7414. 87
3 3	190. 11	3 3	2072. 67	3 3	7703. 73
6 0	216.	13 0	2197.	20 0	8000.
1 1	244. 14	1 1	2326. 20	1 1	8303. 76
2 2	274. 62	2 2	2460. 37	2 2	8615. 12
3 3	307. 55	3 3	2599. 60	3 3	8934. 17
7 0	343.	14 0	2744.	21 0	9261.
1 1	381. 07	1 1	2893. 64	1 1	9595. 70
2 2	411. 87	2 2	3027. 52	2 2	9938. 37
3 3	465. 48	3 3	3290. 46	3 3	10289. 11

Root.

Root.	Cube	Root.	Cube	Root.	Cube
22 0	10648.	31 0	29791.	40 0	64000.
1 1	11015. 14	1 1	30517. 58	1 1	65207. 51
2 2	11390. 62	2 2	31255. 87	2 2	66430. 12
3 3	11774. 52	3 3	32005. 98	3 3	67667. 93
23 0	12167.	32 0	32768.	41 0	68921.
1 1	12568. 08	1 1	33542. 01	1 1	70189. 45
2 2	12977. 87	2 2	34328. 12	2 2	71473. 37
3 3	13396. 48	3 3	35126. 42	3 3	72772. 86
24 0	13824.	33 0	35937.	42 0	74088.
1 1	14260. 51	1 1	36759. 95	1 1	75418. 90
2 2	14705. 12	2 2	37595. 37	2 2	76765. 62
3 3	15160. 92	3 3	38443. 26	3 3	78128. 30
25 0	15625.	34 0	39304.	43 0	79507.
1 1	16098. 45	1 1	40177. 39	1 1	80901. 83
2 2	16581. 37	2 2	41063. 63	2 2	82881. 86
3 3	17073. 86	3 3	41962. 80	3 3	83740. 23
26 0	17576.	35 0	42825.	44 0	85185.
1 1	18087. 89	1 1	43800. 33	1 1	86644. 26
2 2	18609. 62	2 2	44738. 87	2 2	88121. 12
3 3	19141. 30	3 3	45690. 73	3 3	89614. 67
27 0	19683.	36 0	48656.	44 0	91125.
1 1	20234. 83	1 1	47634. 76	1 1	92652. 20
2 2	20796. 87	2 2	48627. 12	2 2	94196. 37
3 3	21369. 23	3 3	49633. 17	3 3	95757. 61
28 0	21972.	37 0	50653.	45 0	97336.
1 1	21545. 26	1 1	51686. 70	1 1	98931. 64
2 2	22149. 12	2 2	52734. 37	2 2	100544.46
3 3	22763. 67	3 3	53796. 11	3 3	102175.05
29 0	24389.	38 0	54872.	46 0	103823.
1 1	25025. 20	1 1	55962. 14	1 1	105488.58
2 2	25672. 37	2 2	57066. 62	2 2	107171.87
3 3	26330. 61	3 3	58185. 55	3 3	108872.98
30 0	27000.	39 0	55419.	47 0	110592.
1 1	27680. 64	1 1	60467. 08	1 1	112329.01
2 2	28372. 62	2 2	61629. 88	2 2	114084.12
3 3	29076. 05	3 3	62807. 48	3 3	115857.22

Root

Root	Cube	Root	Cube	Root	Cube
49 °	117649. 119458.95 121287.37 123134.35	58 °	195112. 197645.89 200201.62 202779.29	67 °	300753. 304142.33 307546.87 310976.73
50 °	125000. 126884.39 128787.62 130709.80	59 °	205379. 208008.28 210644.87 213311.23	68 °	314432. 317912.76 321419.12 324951.17
51 °	132691. 134611.33 136590.87 138589.73	60 °	216000. 218711.26 221441.13 224201.67	69 °	329199. 332092.70 335702.37 339338.11
52 °	140608. 142645.65 144703.12 146780.17	61 °	216981. 229781.20 232608.37 235456.61	70 °	343000. 346688.14 350402.62 354143.54
53 °	148877. 150993.70 153130.37 155287.11	62 °	238328. 241222.64 244140.62 247082.04	71 °	357911. 361705.08 365525.87 369373.48
54 °	157464. 159661.14 161878.62 164116.54	63 °	250047. 253035.57 256047.87 259083.98	72 °	373348. 377149.51 381078.12 385033.92
55 °	167375. 168654.08 170953.88 173274.48	64 °	262244. 265228.01 268336.12 271468.42	73 °	389017. 393027.45 397065.37 401130.86
56 °	175616. 177978.51 180362.12 182766.92	65 °	271625. 277805.95 281011.57 284241.35	74 °	405224. 409344.89 413493.62 417670.30
57 °	185193. 187640.45 190109.37 192599.35	66 °	287496. 290775.39 294079.63 297408.75	75 °	411875. 426107.83 430368.87 434658.23

Root	Cube.	Root	Cube.	Root	Cube.
76 °	438976. 443322.26 447697.12 452100.67	85 °	614125. 619559.70 625026.17 630525.11	94 °	830584. 837228.64 843908.62 850624.04
77 °	456533. 460994.20 465484.37 470003.61	86 °	636056. 641619.14 647214.62 652842.54	95 °	857375. 864161.58 870983.87 877841.98
78 °	474522. 479129.64 483736.62 488373.04	87 °	658503. 664196.07 669921.87 675680.48	96 °	884736. 891666.01 898632.12 905634.42
79 °	493039. 497734.58 502459.87 507214.98	88 °	681472. 687296.51 693154.12 699044.92	97 °	915672. 919747.95 926859.37 934007.36
80 °	512000. 516815.01 521660.12 526535.95	89 °	705669. 710926.15 716917.37 722941.86	98 °	941192. 948413.39 955671.62 962966.79
81 °	531441. 536376.95 541343.37 546340.36	90 °	729000. 735091.89 741217.62 747377.29	99 °	970299. 977668.33 985074.87 992518.73
82 °	550408. 556426.39 561515.62 568357.97	91 °	753571. 759798.82 766060.87 772357.23	100	1000000.
83 °	571787. 576969.33 582182.87 587427.73	92 °	778688. 785053.26 791453.12 797887.67		
84 °	592604. 598011.76 603351.12 608722.17	93 °	804357. 810861.20 817400.37 823974.61		

As 7. 31 Pound (the *weight* of the *Shot* of 3 Inch. 3 Quar.)
Is to 52.73 (the *Cube* of 3 Inch. 3 Quarters:
So is 16 Pound (the *Weight* of the *Shot* whose *Diameter* is
fought.)

To 115, Which Number being found in the second Column of the Table (or the nearest to it, which is 107. 17) the *Root* answering to this Number is 4 Inches 3 Quarters, for the *Diameter* of the *Shot*, whose *Weight* is 16 Pound.

Quest. III. If a Saker whose greatest thickness is 11 Inches and a half, do weigh 1900 Pound: What will the *Weight* of another Saker be, whose greatest thickness is eight Inches and three Quarters.

By the Table I find the *Cube* of 8 Inches 3 Quarters to be 669. 92, and the *Cube* of 11 Inches and a half to be 1520.85:

Then say by Proportion:

As 1520. 85 (the *Cube* of the *Diameter* of the Piece whose *Weight* is known)

Is to 1900, (the *Weight* of the Piece:)

So is 669. 92 (the *Cube* of the *Diameter* of the Piece whose *Weight* you would know),

To 837 Pound almost.

Multiply 669. 92 (the *Cube* of 8 Inch. 3 Q.) by 1900 (the *Weight*) the Product will be 1272848. 00, which divided by 1520. 85, the *Cube* of 11 Inch. 3 Qu. the Quotient will be 837 Pound almost, for the *Weight* of the Piece (or Saker) whose greatest thickness is 8 Inch. 3 Quar.

This is, if the two Pieces were of the same Metal, (as both Brass:) But if the Piece whose *Weight* you seek had been Iron: then having performed all the former work, as if they had been both Brasses; you must then work another Proportion: For, the Proportion of the *Weight* between Brass and Iron being as 16 to 18 (as I have shewed in the following Chapter XVI. of this Book) Brass being the heavier: Then say,
As 18 (the *Weight* of Brass)

Is to 16 (the *Weight* of Iron),

So is 837 (the *Weight* of the Piece if it had been Brass),

To 744 (the *Weight* thereof, if being of Iron.

Quest.

Quest. IV. If a Saker of 3 Inch. 3 Quar. Diameter at the Bore, require 4 Pound of Powder for her Charge, What will a Demi-Cannon of 6 Inches and a half Diameter at the Bore require for her Charge?

The *Cube* of 3 Inch. 3 Qu. is 52. 73: And the *Cube* of 6 Inch. and a half is 274. 62;

Then say, As 52. 73 (the *Cube* of 3 Inch. 3 Quar.)

Is to 274. 62 (the *Cube* of 6 Inch. and a half),
So is 4 Pound (the Load for 3 Inches 3 Quarters),

To 20.81 Pound (the Load for 6 Inches and a half)

You are here to Note, That the Demi-Cannon should be fortified so well as the Saker: The *Cube* of the *Diameter* of the Demi-Cannon is 274, of the Saker 52; the *Weight* of the Saker 1600: What should the *Weight* of the Demi-Cannon be?

Say, As 52 (the *Cube* of the Bore of the Saker),

Is to 274 (the *Cube* of the Bore of the Demi-Cannon),

So 1600 (the *Weight* of the Saker),

To 8431 (the *Weight* that such a Demi Cannon should be of, to bear such a Charge proportionably to the Saker.)

But suppose the Demi Cannon to be no more then 6000 Weight; then Multiply 6000 by 20.81 (the Charge already Calculated), the Product will be 12486000, which if you divide by 8431 (the *Weight* the Demi-Cannon should be of) the Quotient will be 14. 8, that is 14 Pound and 8 Tenths of a Pound, which will be a sufficient Charge for such a Piece.

Quest. V. A Granado-shell being 14 Inches Diameter, and two Inches and a half substance in Metal, what is the weight of the Metal, and the content of the Concavity of the Shell in Cubical Inches.

1. The *Cube* of 14 the *Diameter* of the Shell, is 2747; which multiplied by 11, the Product is 30184, and that divided by 21, the Quotient is 1437 $\frac{1}{3}$, which is the solid Inches in the whole, Metal and Concave both, as if it were a solid Bullet of 14 Inches Diameter.

2. For the Concavity, the thickness of the Metal being 2 $\frac{1}{2}$ Inches, the double thereof is 5 Inches, which subtracted

R

from

from 14 Inches, there remains 9 Inches, for the Diameter of the Concave of the Shell; then the Cube of 9 is 729; which multiplied by 10 produceth 8019; and that divided by 21, the Quotient will be 381 $\frac{7}{21}$ for the solid Inches contained in the Concavity of the Shell; the 381 being Subtracted from 1437, (omitting the Fractions in both Numbers) the remainder is 1056 Inches, the Cubical Inches of the Metal.

3. And because one Cubical Inch of Cast-Iron is by experience found to weigh 4 Ounces, multiply 1056 by 16, (the number of Ounces in one Pound), the Product will be 16896 Ounces, which divided by 4, the Quotient will be 4224, and that Number divided by 16, (the Number of Ounces in one Pound), the Quotient will be 264 Pounds, for the Weight of the Granado-Shell.

Quest. VI. *By the Mould and Burthen one Ship being known, how to build another Ship of the same Mould, of any assigned Burthen, greater or lesser.*

Suppose a Ship of 100 Tun, is found to be 44 foot long in the Keel, 20 foot broad upon the Midship beam, 9 foot deep in the Hold, and did Rack it with the Stem forwards 13 foot, and offward 7.

If (according to these Dimensions) you would build a Ship whose Burthen should be 200 Tun, the several Dimensions of the Members may be found as followeth.

1. For the Keel, it being 44 foot, the Cube thereof is 85184, double this Number (because the Ship you are to build is double the Burthen of the other, viz. 200 Tun), and it makes 170368, the Cube-Root whereof is 55, 441 foot; which is 55 foot, 4 Inches $\frac{1}{4}$ of an Inch, for the length of the Keel.

2. For the breadth upon the Midship beam 20 foot; the Cube of 20 is 8000, the double whereof is 16000, whose Cube-Root is 25, 20 foot, that is 25 foot, 2 Inches and $\frac{1}{2}$ of an Inch, for the breadth upon the Midship beam.

3. For the depth in Hold 9 foot, the Cube of 9 is 729, the double whereof is 1458, whose Cube-Root is 11, 34 foot; that is 11 foot, 4 Inches for the depth in Hold.

4 For

4. For the Rack forward 13 foot; the Cube of 13 is 2197, the double whereof is 4394, whose Cube is 16, 38 foot; that is 16 foot, 4 Inches and a half for the Rack forward.

5. For the Rack offwards 7 foot; the Cube of 7 is 343 the double whereof is 686, whose Cube-Root is 8, 82 foot; which is 8 foot, 9 Inches, and $\frac{1}{4}$ of an Inch, for the Rack offwards.

This is the natural way of working of these and the like Proportions, but when you have many Lengths to find, you may ease your self of extracting so many Cube Roots, for having found out one of them by the Cube-Root, you may find out all the rest by the Golden Rule of Proportion: Thus, having found the Length by the Keel to be 55, 44, and you would find the length of the Midship beam proportionable to this, which in the Ship of 100 Tun was 20 foot: Say,

As 44 the length by the Keel of the Ship of 100 Tuns,
Is to 55, 44 the length by the Keel of the Ship of 200 Tuns,
So is 9 foot, the depth in the Hold of the Ship of 100 Tuns,
To 11, 34, the depth in the Hold of the Ship of 200 Tuns.

And so of all the Members, as in this Synopsis,

1. For the Midship beam:

As 44 is to 55, 44, so is 20 to 25, 20:

2. For the Depth in Hold:

As 44 is to 55, 44, so is 9 to 11, 34:

3. For the Rack forward:

As 44 is to 55, 44, so is 13 to 16, 38:

4. For the Rack offward:

As 44 is to 55, 44, so is 7 to 8, 82:

Or thus, having the proportion of one Cube to another Cube, you may work by that in this manner.

The Cube of	1 Being	1. 000	thereof is	1. 260	And
	2 The Double			1. 442	
	3 The Triple			1. 557	
	4 The Quadruple			1. 710	
	5 The Quintuple			1. 817	
	6 The Sextuple			1. 913	
	7 The Septuple			2. 000	
	8 The Octuple				

R 2

And thus, by the foresaid Supposition a Ship of 100 Tuns being 44 Foot by the Keel, the Length of the Keel for a Ship of 200, 300, 400 Tun, may be found by these Proportions :

Tuns.		Feet.
200	Say, as 1. 100	55. 440
300	is to 44, fo	63. 448
400	is	69. 828
500		75. 240
600		79. 948
700		84. 172
800		88. 000

And from these few Proportions may be deduced many more, but these shall suffice to shew the use of the Cube-Root in this particular.

CHAP. XVI.

Concerning the Proportion of the Weights of Iron, Lead, Stone, &c. And how by knowing the Weight of one Shot of Lead, to find the Weight of another of the like Diameter of Iron or Stone.

THE Proportion between Lead and Iron is as 2 is to 3 ; So that a Shot of 3 Pounds Weight of Lead, will be of equal Diameter to one of Iron of two Pound Weight.

Lead	Brass	24	19
Stone	is as	4	1
Iron	and	16	18
Stone	is as	3	8

By these Proportions, may be easily Calculated (in case Iron Shot be wanting, and Lead or Stone may be had), what Diameter and Weight, Shot either of Lead, Brass or Stone ought to be of, to fit any Piece of Ordnance : And from these Proportions the following Table is Calculated, for all Shots of Lead, Iron, and Stone, from two Inches Diameter to 8 Inches Diameter, by Inches, Halves and Quarters.

A Table shewing the Weight of any Shot of Iron, Lead, or Stone, from 2 to 8 Inches Diameter.

Inches	Quart.	Lead, Po. Oz.	Iron, Po. Oz.	Stone, Po. Oz.
2	0	1 10 1	1 10	7
	1	2 6	9 0	9
	2	3 2	2 0	12
	3	4 5	14 1	1
3	0	5 10	3 12	7
	1	7 24	12 1	13
	2	8 15	6 0	4
	3	11 0	7 5	12
4	0	13 7	8 15	3 6
	1	16 0	10 10	4 0
	2	18 15	12 10	4 12
	3	22 5	14 14	5 9
5	0	26 2	17 5	6 8
	1	30 2	20 17	8 8
	2	34 11	23 28	11 11
	3	39 3	26 6	14 14
6	0	45 0	30 0	11 4
	1	51 0	34 0	12 12
	2	57 0	38 0	14 4
	3	62 0	42 0	15 12
7	0	72 0	48 0	18 0
	1	79 8	53 0	20 0
	2	87 0	58 0	22 12
	3	96 0	63 0	24 0
8	0	106 0	71 0	26 10

By this Table you may see, That if a Gun carry a Shot of 5 Inches and a half Diameter, that Shot, if of Lead, will weigh 34 Pound 11 Ounces. — If of Iron 23 Pound 2 Ounces : If of Stone but 8 Po. 11 Ounces, and so of any other, as in the Table.

Note, The Stone here meant is Marble, Pebble, and such like, other Stone being more soft and porous ; and consequently lighter.

Also Note, That in loading your Gun for a Stone-shot you are not to give her the same Charge of Powder as for one of Lead or Iron, but abate according as the Proportions of the Metals are.

If you compare this Table with the former Table of Cube Roots, you shall find the Cube of each Number bear the like proportion one to another, as the Weight of

each Bullet is one to another of the same Metal.

Example. The Cube of 3 and 3 Quarters is 52. 73 :

The Weight of an Iron Shot, which is 3 Inch. 3 Quart. is 7 Pound 5 Ounces, (or Decimally) 7. 31 : The

The *Cube* of 4 Inch. 3 Qu. is 107. 17:

The *Weight* of an Iron-Shot of that Diameter is 14 Pound 14 Ounces (or Decimally 14. 87) which is 4 Ounces more than double 7. 31, for 7. 31 doubled is 14. 62.

So likewise 52. 73 doubled is 105. 46, which does not exceed 107. 17 (the *Cube* of 3 Inch. 3 Quart.) being fo doubled.

CH A P. XVII.

Concerning Gunpowder, and to find what quantity will fill any Granado Shell or Cartridge.

IT hath been often Experimented in the *Tower of London*, that one Pound of Powder will fill 31 *Cubical Inches*, and 600 parts, which is, a little above half one tenth part of an Inch: This being allowed, it will be no hard matter to know what quantity of Powder will fill any *Granado-shell*, or *Cartridge*. For the Proportion will be,

As 33.06 *Cubical Inches*,

Is to One Pound of Powder;

So is any other Number of *Cubical Inches*,

To the Number of Pounds of Powder that will fill those *Inches*.

Whether it be *Granado shell* or *Cartridge*.

But this work being something troublesome, I shall here exhibit a *Table*, which by inspection only, will tell you what quantity of Powder will fill any *Granado-shell*, whose true Diameter is known, provided the *Shell* be perfectly Round.

A Table shewing what Quantity of Powder (in Pounds and hundred parts of a Pound) will fill any *Granado-Shell* whose Diameter is known:

		Tenths of Inches.									
		0	1	2	3	4	5	6	7	8	9
Whole Inches in Diameter :	1	00.01	00.02	00.03	00.04	00.05	00.06	00.07	00.08	00.10	00.12
	2	00.14	00.16	00.18	00.20	00.28	00.26	00.28	00.32	00.37	00.41
	3	00.45	00.50	00.55	00.61	00.66	00.72	00.79	00.86	00.92	01.00
	4	01.08	01.16	01.25	01.34	01.44	01.54	01.64	01.75	01.86	01.98
	5	02.11	02.22	02.37	02.51	02.65	02.80	02.96	03.12	03.29	03.46
	6	03.64	03.83	04.02	04.17	04.42	04.63	04.84	05.07	05.30	05.54
	7	05.78	06.03	06.29	06.56	06.83	07.11	07.40	07.70	08.00	08.31
	8	08.65	08.96	09.30	09.64	09.97	10.25	10.73	11.10	11.39	11.89
	9	12.29	12.70	13.13	13.56	14.00	14.45	14.92	15.39	15.87	16.36
	10	16.86	17.35	17.89	18.42	18.97	19.52	20.08	20.66	21.24	21.83
	11	22.44	23.06	23.69	24.32	24.98	25.64	26.32	27.00	27.70	28.41
	12	29.14	29.87	30.57	31.37	32.15	32.93	33.72	34.53	35.35	36.19
	13	37.04	37.91	38.77	39.67	40.56	41.48	42.41	43.36	44.31	45.28
	14	46.26	47.26	48.27	49.30	50.34	51.40	52.47	53.56	54.66	55.77
	15	59.90	58.04	59.21	60.39	61.58	62.78	64.01	65.24	66.50	67.73
	16	69.06	70.36	71.68	73.02	74.37	75.74	77.12	78.53	79.94	81.38

The Use of this Table.

Exam. 1. If the Diameter of a *Granado-Shell*, be 7 Inches, how many Pounds of Powder will fill the same?

Look for 7 in the first Column of the Table towards the left hand, and right against it you shall find 5.78, which is 5 Pound, and 78 hundred parts of a Pound, which is somewhat above 3 Quarters of a Pound: And so much will fill such a *Shell*.

Exam. 2. Suppose the Diameter of a *Granado-Shell* to be 15 Inches and 4 Tenths of an Inch: How much Powder will fill that *Shell*?

This

This is such a Shell as was mentioned in the Third *Example* of *Chap. XIV.*

Look for 15 Inches in the first Column of the Table towards the left hand, and for 4 Tenths of an Inch in the head of the Table; and against 15, and under 4, you shall find 61. 58, which is 61 Pounds, and 58 hundred parts of a Pound, which is somewhat above half a Pound,

C H A P. XVIII.

Concerning the Allowance of Powder for the Charge of any well Fortified Gun either Braß or Iron; according to the Weight thereof, from one hundred to ninety hundred Weight of Metal.

A Well Fortified Gun, hath her Metal at the Vent or Touch-hole as thick as her Diameter at the Bore: Now Gunners do allow three Ounces of Powder for every hundred Weight of Metal in Iron Guns: and Four Ounces for every hundred Weight of Metal in Braß Guns: According to this Allowance.

How much Powder must be allowed for the Charge of an Iron Gun, whose Weight is 22 hundred:

The Allowance for Iron Guns being 3 Ounces, Multiply 22 (the hundred Weights) by 3 (the allowance for Iron Guns) the Product will be 66, which divide by 16 (the Ounces in one Pound) the Quotient will be 4 and 2 remaining, which is 4 Pound and 2 Ounces; So that 4 Pound and 2 Ounces of Powder, will load such an Iron Gun.

But for a Braß Gun of the same Weight you must Multiply 22 by 4, and the Product will be 88, which divided by 16, the Quotient will be 5 Pound and 8 Ounces remaining, and so much must be allowed for a Braß Gun of 22 hundred Weight.

And according to this Rule the following Table was made both for Braß and Iron Guns, from one hundred weight to 90 hundred Weight. A

A Table shewing what Quantity of Powder is to be allowed for the Charge of any Braß or Iron Piece of Ordnance.

C.	Braß.	Iron.	C.	Braß.	Iron.	C.	Braß.	Iron.	
W	Po.	Ou.	W	Po.	Ou.	W	Po.	Ou.	
1	00	04	00	03	31	07	12	05	13
2	00	08	00	06	32	08	00	06	00
3	00	12	00	09	33	08	04	06	03
4	01	00	00	12	34	08	08	06	06
5	01	04	00	15	35	08	12	06	09
6	01	08	01	02	36	09	00	06	12
7	01	12	01	05	37	09	04	06	15
8	02	00	01	08	38	09	08	07	02
9	02	04	01	11	39	09	12	07	05
10	02	08	01	14	40	10	00	07	08
11	02	12	02	01	41	10	04	07	11
12	03	00	02	04	42	10	08	07	14
13	03	04	02	07	43	10	12	08	17
14	03	08	02	10	44	11	00	08	04
15	03	12	02	13	45	11	04	08	07
16	04	00	03	00	46	11	08	08	10
17	04	04	03	03	47	11	12	08	13
18	04	08	03	06	48	12	00	09	00
19	04	12	03	09	49	12	04	09	03
20	05	00	03	12	50	12	08	09	06
21	05	04	03	15	51	12	12	09	09
22	05	08	04	02	52	13	00	09	12
23	05	12	04	05	53	13	04	09	15
24	06	00	04	08	54	13	08	10	02
25	06	04	04	11	55	13	12	10	05
26	06	08	04	14	56	14	00	10	08
27	06	12	05	01	57	14	04	10	11
28	07	00	05	04	58	14	08	10	14
29	07	04	05	07	59	14	12	11	01
30	07	08	05	10	60	15	00	11	04

S

And

The Use of the TABLE.

If an Iron or Brass Gun do weigh 57 hundred Weight, what Quantity of Powder must be allowed for her Charge.

Look for 57 in the Column of the Table that hath *CW* at the top of it, signifying hundred Weight; and against 57 (towards the right hand) you shall find 14 Pound 4 Ounces for to Load a Brass Gun; and 10 Pound 11 Ounces to Load an Iron Gun of 57 hundred Weight.

CHAP. XIX.

Concerning Cartredges, how to make them, and fit them, fitting for the Bore, or Chamber of any Piece of Ordnance.

I. How Cartredges are made.

Cartredges are made of *Stiff Paper*, or *Canvass*, the breadth of which must be three Diameters of the *Bore* of the Chamber of the Gun for which it is made, and about four Diameters for the length: These pieces (if *Canvass*) must be sewed about a *Former*, which is a round piece of Wood, which must be a very little less than the Diameter of the *Bore* (or *Chamber*) of the Gun; unto which a Bottom of *Canvass* must also be sewed: But if you make your Cartredge of *Paper*, then must you rowl the Paper about the *Former*, and past the Edges together, and also fit a Bottom thereto.

II. How

II. How to fill Cartredges.

The Diameter of the Cartredge, and the Pounds of Powder that will Load the Piece, being known to find the length of the Cartredge when filled.

Let the Diameter given be 6. 3 (that is 6 Inches and 3 tenth parts of an Inch) and let the quantity of Powder be 14. 5 (that is 14 Pound and a half.) And let it be required, to find how high the Cartredge must be filled, that it may hold just so much Powder.——To effect this it will be requisite to find the Area of the Circle of the Cartredge in Inches and *D decimal parts* of Inches: to find which this is the Proportion:

As 28, Is to 22;

So is the Square of the Diameter 39. 69 Inches,

To the Area, 31. 18 Inches.

Multiply 6. 3. the Diameter in it self, and the Product will be 39. 69 Inches, which is the Square of the Diameter; this (always) Multiply by 22, and it produceth 873. 18, which divide (always) by 28; and the Quotient will be 31. 18 Inches, and so many Square Inches are contained in the Area of the Circle of the Cartredge.

Exam: *The Area thus found, the Weight of Powder for Loading 14. 5 Pound, and the number of Cubical Inches in one Pound of Powder, viz. 31.06 known: To find how high the Cartredge must be filled.*

This is the Proportion:

As the Inches in the Area of the Circle 31. 18,

Is to the Powder allowed for Loading; 14. 5 Pound,

So is the Cubical Inches in one Pound of Powder, 31.06,
To the depth of the Cartredge to be filled 14. 4 Inches:

Wherefore,

Multiply 31.06 (the Inches in one Pound of Powder) by 14. 5 Pound (the allowance for Loading), the Product will be 450. 370; which divided by 31. 18 (the Inches in the

S 2

Circle

Circle of the Cartredg) the Quotient will be 14. 44 Inches, which is 14 Inches, and 44 hundred parts of an Inch, and so high must the Cartredg be filled.

This is the *Arithmetical* way to perform this Work, but it may be much abbreviated by help of this little Table following, which will require but one single Multiplication.

Inches in the Diam. of the Carr. or Sh.	Tenths of Inches in the Diameter of the Cartredg or Shot.									
	0	1	2	3	4	5	6	7	8	9
	In. 1000 parts.	In. 1000 parts.	In. 1000 parts.	In. 1000 parts.	In. 1000 parts.	In. 1000 parts.	In. 1000 parts.	In. 1000 parts.	In. 1000 parts.	In. 1000 parts.
2	9.889	8.970	8.173	7.471	6.868	6.330	5.852	5.427	5.046	4.704
3	4.395	4.117	3.863	3.641	3.432	3.229	3.053	2.890	2.740	2.601
4	2.473	2.353	2.243	2.141	2.041	1.954	1.879	1.791	1.717	1.648
5	1.582	1.522	1.463	1.408	1.357	1.308	1.258	1.218	1.175	1.127
6	1.099	1.063	1.029	0.996	0.966	0.930	0.908	0.881	0.855	0.831
7	0.806	0.785	0.763	0.742	0.722	0.703	0.685	0.667	0.650	0.634
The Quantity of Depth of the Cartredg; that one Pound of Powder will fill.										

The Use of this Table.

- I. The Diameter of a Cartredg being given to find how much of that Cartredg one Pound of Powder will fill.

Exam. 1. If the Diameter of a Cartredg (or the hollow Chamber or Cylinder of a Gun) be 5 Inches, how much thereof will one Pound of Powder fill?

Look for 5 Inches in the first Column towards the Left hand, against which stands 1.582, which is one Inch, and 582 thousand parts of an Inch, and so much will one Pound of Powder fill of that Cartredg or Cylinder.

Exam.

Exam. 2: If the Diameter of a Cartredg, or Cylinder of a Gun be 4 Inches and 3 Tenths, how much thereof will one Pound of Powder fill?

Look for 4 Inches in the first Column, and for 3 tenths in the head of the Table, and against 4 and under 3, you shall find 2.141, that is, 2 Inches, and 141 thousand parts of an Inch, and so much will one Pound of Powder fill.

II. The Diameter of the Cartredg, 6.3 Inches, and the quantity of Powder that will Load the Gun, 14.5 Pound, being known, to find how much of the Cartredg must be filled to hold so much Powder.

Look for 6 Inches in the first Column, and for 3 in the head of the Table; and against 6, and under 3, you shall find 0.996, that is, no Inches, but 996 thousand parts of an Inch; and so much will one Pound of Powder fill: Now if you multiply 0.996 by 14.5 (the quantity of Powder to Load the Gun) the Product will be 14.44, that is 14 Inches, and 44 hundred parts of an Inch, and so high must the Cartredg be filled: agreeable to the former Example.

CHAP. XX.

Concerning Carriages for Pieces of Ordnance, and how they should be made.

1. Measure the length of the Cylinder of the Gun; once and a half that length should the Carriage be.
2. Measure the Diameter of the Bore of the Piece, four of those Diameters is the depth of the Planks at the fore-end: In the middle three and a half: At the end next the Ground two and a half: And in thickness one Diameter.
3. The Wheels should be one half the Length of the Piece in height: The Saker and Minion Wheels must exceed the former by one twelfth part: The Faucon and Fauconet by one sixth part.

CAU.

CAUTION:

If you find that the Ground is not level on which your Carriage stands, and that one Wheel is higher than the other: The Trunnions out of due place: The Piece not lying truly in the Carriage: The Carriage not truly made: you must get these things amended before you shoot. Otherwise never expect to make a true Shot.

CHAP. XXI.

Concerning Shooting in Great Ordnance, and how to Load your Gun Artificially, either with Powder or Cartredge.

When you come to Charge your Piece, set your Bondge-Barrel on the Wind-side thereof; and causing one of your Matrosses to hold the same aslope, thrust your Ladle in to the same, filling it full of Powder, and then strick it with a Ruler: Then fixing your Thumb just under the Staff of the Ladle, thrust the same home to the Chamber of the Piece, where the Powder is to lie, turning the Ladle so, as your Thumb be directly above the Staff, so will the Powder empty it self cleanly out of the Ladle: Then draw out the Ladle, and with the Tampion at the other end of the Staff, thrust home the Powder, causing one of your Assistants to hold his Finger or Thumb close on the Touch-hole: then take a round close wad of Hay, (or untwisted Rope) thrust in the same with the Rammer head which is at the end of the Sponge Staff, and with it give three or four good strokes; this done, put in your Bullet with a Wad after it, if the Piece be not elevated; but without any Wad after it, the Gun being elevated, for then there is no fear of its rowling out.

If you Load your Gun with a Cartredge (which is the best way) put the Cartredge home with the Rammer, and after it a sufficient Wad.

CHAP.

CHAP. XXII.

How to give Level with a Piece of Ordnance to make a Shot at any mark within Point blank.

First, set your Dispart upright upon the Muzzle-Ring just over the Center of the Mouth of the Piece: Then go to the Base Ring, and make a mark upon the highest part thereof, which is just over the Cylinder (if the Piece be true Bored) and take that for your true line.

This done, go to the Breech of the Piece, and hold your head about two Foot there from, bringing your Eye, the mark upon the top of the Base Ring, the top of the Dispart, and the Mark you are to shoot at, all into one right line: which may be done by causing a Matross to raise or fall the Gun with an Hank-spike, as you shall direct him; and then stop the Motion of the Piece with a Coyne; then Prime the Piece, and give Fire.

CHAP. XXIII.

Shewing how to amend a Shot, which (by some accident) doth carry over, under, or wide of the Mark intended.

WHEN you have made one Shot, which doth not answer your expectation, it must be either Higher, Lower, or Wide of the Mark, or both: To remedy any of which observe these following Rules:

First, If at the first Shot you find the Piece to shoot directly over the Mark; Then so much make your Dispart longer, that the top of it may be just seen from the top of the Base Ring to the stroke of the Shot; and with this new Dispart level your Piece and give Fire.

Secondly,

Secondly, If the *first Shot* had strook juſt under the Mark, then bring the Piece to its former poſition, and mark how much the *Diſpart* is over the ſtroke of the Shot, and cut off of it juſt ſo much as being at the Breech of the Piece, you may diſcern the *top* of it, the *Mark* on the *Baſe Ring*, and the *ſtroke* of the Shot, in a right Line; and when you have brought it to ſuch a length, level the Piece as before; Prime and give Fire.

Thirdly, If the *first Shot* had ſtrook on the *right hand* of the *Mark*; to mend it, you muſt level the Piece as before; then ſtanding at the Breech of the Piece, obſerve the ſtroke of the Shot over the *Diſpart*, and on that part of the Baſe Ring which you then look over in a right line towards the *Diſpart* and ſtroke of the Shot, ſet up a Pin with a little ſoft Wax: Then level your Piece to the Mark by this Pin and the *Diſpart*, and then doubtleſs you will make a good Shot. — For when you level by the Metal of the Baſe Ring, where the Pin is placed, and the Mark, the Piece ſtanding at that direction, look over the top of the *Diſpart*, from the mark in the Baſe Ring, and you ſhall find the Piece to lie ſo much to the *Left*, as the former Shot ſtrook to the *Right* of the Mark; and ſhould now in all probability hit the *Mark*.

Fourthly, If the *first shot* be both *wide*, and too *high*, or too *low*; then uſe both the foregoing *Directions*: — Firſt, Re-
gulate the *Diſpart* by making it *longer*, or cutting of it *ſhorter*, by the *First* and *Second Directions* hereof, the Shot being *Lower* or *Higher*, and then make Uſe of this *Third Direction*, for Shooting *Wide*: Which things being done with care and diligence, will doubtleſs mend a bad Shot.

CHAP.

CHAP. XXV.

A Table, and the Uſe thereof, whereby you may give Level to a Piece of Ordnance, without the Gunners Rule or Quadrant, to any degree of Mounture under 11 degrees.

The Length of the Gun.	Degrees of Elevation.										
	1	2	3	4	5	6	7	8	9	10	
Five Foot	1	3	6	8	11	14	16	17	19	21	28
Five and a half	1	14	28	42	56	70	84	97	110	126	40
Six Foot	1	22	44	66	88	107	128	148	168	188	29
Six and a half	1	36	72	108	144	180	216	252	288	324	63
Seven Foot	1	47	94	141	187	233	279	325	371	417	73
Seven and a half	1	58	116	174	232	289	347	404	461	518	71
Eight Foot	1	68	136	204	272	339	406	473	540	607	82
Eight and a half	1	79	158	237	316	395	473	551	629	707	92
Nine Foot	1	89	178	267	356	445	533	621	709	797	98
Nine and a half	2	04	06	08	10	12	14	16	18	20	40
Ten Foot	2	10	20	30	40	50	60	70	80	90	48
Ten and a half	2	21	41	61	81	101	121	141	161	181	51
Eleven Foot	2	31	62	93	124	155	185	215	245	275	53
Eleven and a half	2	42	84	126	168	210	252	294	336	378	56
Twelve Foot	2	53	106	159	212	265	317	369	421	473	58
Twelve and a half	2	63	126	189	252	315	377	439	501	563	60
Thirteen Foot	2	74	148	222	296	369	442	515	588	661	63
Thirteen and a half	2	84	168	252	336	419	502	585	668	751	67
Fourteen Foot	2	95	190	285	380	473	566	659	752	845	70

The Use of this Table.

If you are destitute both of a *Quadrant* or a *Gunnerys Ruler*, yet may you *Level* a *Gun* to any degree of *Mounture* under eleven deg.

Exam. 1. Suppose you have a *Gun* whose length is 9 Foot and half, and you would elevate it to 5 degrees of *Mounture*.

Look in the Table for the length of the *Gun*, 9 Foot and a half, in the first Cumb of the Table, and in that Line under 5 deg. you shall find 10. 0, which is just 10 Inches, wherefore take any strait stick, and cut it off at that length, which set perpendicularly upon the top of the *Base Ring*, and level over the top of the *Stick*, as if it were the hole in the *Slider* of the *Ruler*, and the top of the dispart upon the *Muzzle Ring*, and you will make a good Shot.

Exam. 2. Suppose your *Gun* were 12 Foot long, and you would Mount her to 7 degrees of *Elevation*.

Look for 12 Foot long in the first Cumb, and for 7 deg. in the head of the Table, and against 12 Foot, and under 7 deg. you shall find 17. 71, which is 17 Inches and 71 hundred parts of an Inch (which is almost 3 quarters of an Inch) a *Stick* of that length set perpendicularly upon the *Base Ring*, you may level over it by the top of the *Dispart* on the *Muzzle Ring*, as if it were through the hole in the *Slider*.

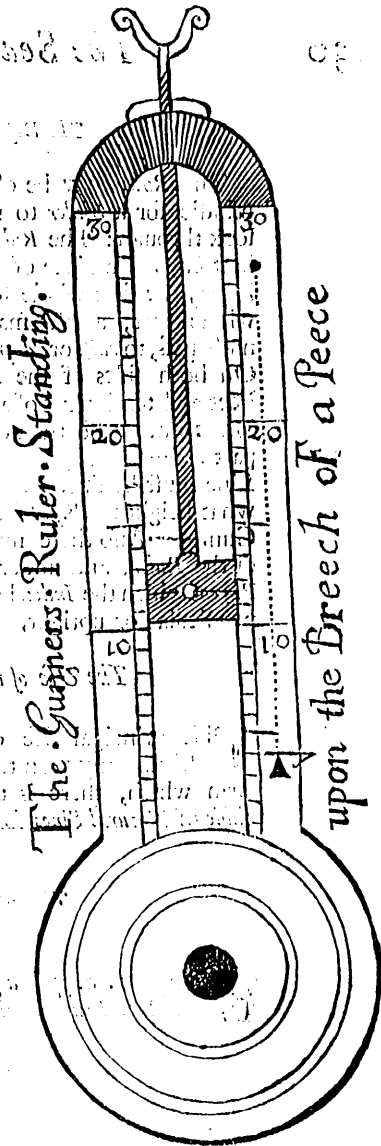
But if you would *Level* without a *Dispart*, then take the *Dispart* off, and lay it to the foresaid *Stick*, cutting so much of it off, as was the length of the *Dispart*; then set the remainder of the *Stick* upon the *Base Ring*, and bring the top of the *Stick*, the *Metal* of the *Muzzle Ring*, and the *Mark* in one Right line, then *Prime* and give *Fire*, and doubtless you will make a good Shot.

CHAP.

CHAP. XXIV.

Concerning a *Gunner's Ruler*, for the Elevating of any Piece of Ordnance to any degree of *Mounture*, supplying the Use of the *Gunner's Quadrant*.

Forasmuch as a *Quadrant* cannot at all times be conveniently used; as when the *Wind* is high: Also in taking the depth or profundity of a *Valley*, or altitude of a *Hill*, &c. For the removing of all which inconveniencies this *Gunner's Rule* was invented, the Description and Figure whereof follow:



T

The

The Description of the RULER.

The Ruler may be of any length, with a large *Slit* in the middle for a *Slider* to move in, and in the *Slider* a *Hole* to look through: The Ruler must be slit quite through at the bottom, and a piece of Brass fastned over it; but at the top it may be left whole for half an Inch or more; in which whole part, a *Nut* may be fastned, through which a *Screw* must pass, to raise or lower the *Slider* as occasion requires: On both sides of the *Slit*, the Ruler must be divided into Feet and tenth parts of a Foot; and every one of those parts into 10 more, so then every Foot will be divided into 100 parts. Through the Center of the little Hole, a small Line must be drawn quite thro' the *Slider*, which will shew at what height the *Sight-hole* standeth from the *Base Ring* of the Gun. Also there must be an *Index* to hang on the edge of the Ruler, and under it a small *Pin*, perpendicular to the *Pin* on which the *Index* hangeth; which is to set the Ruler perpendicular or upright.

The Use of the RULER.

The principal Use of the Ruler is (as I said before) to Elevate any Gun to any degree of Mounture. To perform which, there is to be used with the Ruler, this brief Table of Natural Sines following.

The use of the Table.

Example 1. Suppose a Gun, which is 8 Foot, and 7 Tenths of a Foot Long, between the Base and Muzzle Rings, the which Gun being Mounted and Disparted, is to be Elevated to 2 Degrees and 6 Tenths of a Degree of Mounture.

A Table

A Table to be used with the Gunners Rule.

Tenth Parts of a Degree of Mounture.									
0	1	2	3	4	5	6	7	8	9
0	00174	00349	00524	00698	00873	01047	01222	01396	01571
1	01745	01920	02094	02269	02443	02618	02792	02967	03141
2	03490	03664	03839	04013	04188	04362	04536	04711	04885
3	05833	05402	05582	05756	05931	06105	06279	06453	06627
4	06975	07150	07324	07498	07672	07846	08020	08194	08368
5	08715	08889	09063	09237	09411	09585	09758	09932	10106
6	10452	10626	10780	10973	11147	11320	11494	11667	11840
7	12187	12360	12533	12706	12880	13053	13226	13399	13572
8	13917	14090	14263	14436	14608	14781	14954	15126	15299
9	15643	15816	15988	16160	16333	16505	16677	16849	17021
10	17365	17537	17708	17880	18051	18224	18395	18567	18738
11	19081	19252	19423	19595	19766	19937	20108	20279	20450
12	20791	20962	21132	21303	21474	21644	21814	21985	22155
13	22495	22665	22835	23005	23175	23345	23514	23684	23853
14	24192	24362	24531	24700	24869	25038	25207	25376	25545
15	25882	26051	26219	26387	26556	26724	26892	27060	27228
16	27564	27731	27899	28067	28234	28401	28569	28736	28903
17	29237	29404	29571	29737	29904	30071	30237	30403	30570
18	30902	31069	31233	31399	31565	31730	31896	32061	32227
19	32557	32722	32887	33051	33216	33381	33545	33710	33874
20	34202	34366	34530	34694	34857	35021	35184	35347	35511
21	35837	36000	36162	36325	36488	36650	36812	37002	37110
									37295

T 2

Forasmuch

Forasmuch as the Gun is to be elevated 2 degrees and 6 Tenth parts of a degree; Look for 2 degrees in the first Column of the Table, and for 6 parts of a degree in the head thereof; And against 2, and under 6, you shall find this Number, 04536, which multiply by 8.7 (the length of the Gun in Feet and decimal parts of a Foot) the Product will be, 0394632, from which cut off (towards the right hand) five Figures for the Number taken out of the Table, and one for the 7 Tenths in length of the Gun, in all six Figures, then will the Product stand thus 0.394632, which 0 to the left hand is no Feet, but the 3 following is 3 Tenth parts of a Foot, and the 9 following is 9 Tenths of a Tenth part of a Foot, which is near 4 Tenth parts of a Foot, and to that Number on the sides of the Ruler, must the stroke (and hole) in the Slider be brought, and then the Ruler is rectified for that Elevation.

Exam: 2. Suppose a Cannon, whose Length is 11 Foot and 3 Tenths of a Foot, were to be Mounted to 14 deg. and 4 Tenths of a degree, to what divisions on the sides of the Ruler must the Slider be set?

Look in the first Column of the Table for 14 deg. and for 3 Tenths in the head of the Table, so against 14, and under 4, you shall find this number, 24869, which being multiplied by 11.3 Foot, the length of the Gun, the Product will be 2810197; from which cut off 5 Figures for the number in the Table, and 1 for the 4 Tenths in the length of the Gun, it will stand thus 2.810197, which is 2 Foot, and 8 Tenth parts of a Foot, and to that number on the sides of the Ruler, must the Slider be set, to mount the Cannon to 14.4 deg. of Elevation.

C H A P.

C H A P. XXV.

A Table, and the Use thereof, whereby you may give Level to a Piece of Ordnance, without the Gunners Rule or Quadrant, to any degree of Mounture under eleven degrees.

The Length of the Gun.	Degrees of Elevation.									
	1	2	3	4	5	6	7	8	9	10
Five Foot	1	3	6	8	11	14	16	19	21	28
Five and a half	1	14	28	42	56	70	84	98	121	40
Six Foot	1	22	44	66	88	107	128	158	188	29
Six and a half	1	36	72	108	144	180	216	252	288	63
Seven Foot	1	47	94	141	187	234	281	328	375	73
Seven and a half	1	58	116	174	232	290	348	406	464	71
Eight Foot	1	68	136	204	272	340	408	476	544	82
Eight and a half	1	79	158	237	316	395	474	553	632	92
Nine Foot	1	89	178	267	356	445	534	623	712	98
Nine and a half	2	0	0	0	0	0	0	0	0	4
Ten Foot	2	10	20	30	40	50	60	70	80	8
Ten and a half	2	21	41	61	81	101	121	141	161	20
Eleven Foot	2	31	62	93	124	155	186	217	248	33
Eleven and a half	2	42	84	126	168	210	252	294	336	42
Twelve Foot	2	52	104	156	208	260	312	364	416	53
Twelve and a half	2	63	126	189	252	315	378	441	504	63
Thirteen Foot	2	74	147	220	293	366	439	512	585	74
Thirteen and a half	2	84	168	252	336	420	504	588	672	84
Fourteen Foot	2	95	190	285	380	475	570	665	760	95

The Use of this Table.

If you are destitute both of a *Quadrant* or a *Gunnors Ruler*, yet may you *Level* a Gun to any degree of *Mounture* under eleven deg.

Exam. 1. Suppose you have a Gun whose length is 9 Foot and half, and you would elevate it to 5 degrees of Mounture.

Look in the Table for the length of the Gun, 9 Foot and a half, in the first Columb of the Table, and in that Line under 5 deg. you shall find 10.0, which is just 10 Inches, wherefore take any streight stick, and cut it off at that length, which set perpendicularly upon the top of the *Base Ring*, and level over the top of the *Stick*, as if it were the hole in the *Slider* of the *Ruler*, and the top of the dispart upon the *Muzzle Ring*, and you will make a good Shot.

Exam. 2. Suppose your Gun were 12 Foot long, and you would Mount her to 7 degrees of Elevation.

Look for 12 Foot long in the first Columb, and for 7 deg. in the head of the Table, and against 12 Foot, and under 7 deg. you shall find 17.71 which is 17 Inches and 71 hundred parts of an Inch (which is almost 3 quarters of an Inch) a *Stick* of that length set perpendicularly upon the *Base Ring*, you may level over it by the top of the *Dispart* on the *Muzzle Ring*, as if it were through the hole in the *Slider*.

But if you would Level without a *Dispart*, then take the *Dispart* off, and lay it to the foresaid *Stick*, cutting so much of it off, as was the length of the *Dispart*; then set the remainder of the *Stick* upon the *Base Ring*, and bring the top of the *Stick*, the *Metal* of the *Muzzle Ring*, and the *Mark* in one Right line, then Prime and give Fire, and doubtless you will make a good Shot.

CHAP.

C H A P. XXVI.

Concerning Shooting at Random:

HE that would learn perfectly to Shoot at Random, ought, to draw his *Piece* into a level ground; Where, First, Shooting level, let him observe the distance in Feet or Paces, from the Gun to the *Graze* of the *Bullet*: Then mount his *Piece* to one degree, and mark where that doth graze, noting the distance as before; Then, to 2, 3, 4, &c. degrees, to Ten degrees, and by these *Elevations* and *Distances* make a Table, by which Table, you may, by the *Rule of Proportion*, find how far another *Piece* will carry her Shot from degree to degree of *Elevation*: — But, because, it is probable, that every ordinary Gunner cannot have leave or opportunity (the charge being great) to make such *Experiment*, I shall here exhibit to your View, a short Table of Mr. N.N. by him made out of a *Saker* 8 Foot long, Loaded with 3 Pound of Powder; At the first Shot (at one deg. of Mounture) she conveyed her Shot 1125 Feet, or 225 Paces: The second Shot, at 5 deg. of Mounture she conveyed her Shot 2180 Feet or 416 Paces: At the third Shot, at 7 deg. of Mounture, 505 Paces: And the last at 10 deg. 630 Paces: In which *Experiment*, he loaded his *Piece* with loose Powder exactly Weighed, also he weighed the *Wad*, and beat down the same with the like (or equal) strength; and let the *Piece* cool half an hour between each Shot: Now by this Table and the *Rule of Proportion* may be found to what elevation another Gun must be mounted to reach any distance required:

Degrees of Elevation	Randons in Paces, 5 f. to a Pace.
1	225
2	274
3	323
4	370
5	416
6	461
7	505
8	548
9	589
10	630

Exam.

Exam. Suppose I find by my first Shot, that the Bullet grazed from my Gun 704 Paces, the Mounture of the Pece being 4 deg: How much must I Mount her, so that she may convey her Shot 900 Paces?

These distances of *Randons* are to be proportioned to those in the Table, by this Analogy:

Saying

As 704 Paces, (the *Graze* of the Bullet at 4 deg. of Mounture,) Is to 370 (the Paces against 4 deg. of Mounture)

So is 900, (the number of Paces to be Shot)

To 473, the Number to be found in the Table answerable to the *Degrees* of Mounture required.

Therefore, multiply 370 (the number against 4 deg.) by 900, (the number of Paces to be Shot,) the Product will be 333000, which divided by 704 (the *Graze* of the Bullet at the first Shot) and the Quotient will be 473; which number I should seek in the Table, but finding it not there, I take 461 the next less, against which stands 6 degrees, and 505 the next greater, against which stands 7 deg: the difference between these two numbers is 44, which shows the Piece must be Mounted to 6 deg. and on third part of a degree for to reach the distance of 900 Paces: For 461 is less by 12, then 473, which is near one third part of 44 the difference.

This Table beforegoing was deduced from an experiment made by Mr. Nat Nye the Master Gunner of Worcester in Anno 1647. But this Table being very short, and the use of it to absolutely necessary for Gunners (especially in Land Service) I shall exhibit to their view Two other Tables tending to the same purpose, long since calculated by an able Mathematician, viz. Mr. Henry Bond, which with their Uses take as followeth.

The

The First Table of
RANGES.

D.		D.		D.	
1	8758	31	2391	61	2832
2	7813	32	2344	62	2908
3	7077	33	2300	63	2989
4	6482	34	2260	64	3075
5	5991	35	2221	65	3168
6	5581	36	2183	66	3258
7	5234	37	2146	67	3376
8	4932	38	2111	68	3493
9	4669	39	2077	69	3621
10	4440	40	2044	70	3762
11	4237	41	2012	71	3916
12	4055	42	1981	72	4086
13	3889	43	1952	73	4276
14	3741	44	2007	74	4489
15	3606	45	2041	75	4732
16	3483	46	2076	76	5006
17	3370	47	2113	77	5303
18	3266	48	2150	78	5690
19	3279	49	2189	79	6263
20	3080	50	2230	80	6641
21	2996	51	2272	81	7274
22	2978	52	2317	82	8059
23	2845	53	2363	83	9061
24	2776	54	2412	84	10430
25	2712	55	2463	85	12330
26	2651	56	2516	86	15140
27	2593	57	2572	87	19850
28	2538	58	2633	88	25250
29	2486	59	2695	89	37480
30	2437	60	2762	90	00000

The Second Table of
RANGES.

D.		D.		D.	
1	1.142	31	4.186	61	3.532
2	1.280	32	4.267	62	3.440
3	1.413	33	4.347	63	3.347
4	1.543	34	4.426	64	3.253
5	1.669	35	4.505	65	3.158
6	1.792	36	4.584	66	3.062
7	1.911	37	4.662	67	2.963
8	2.028	38	4.740	68	2.864
9	2.142	39	4.818	69	2.762
10	2.253	40	4.895	70	2.659
11	2.361	41	4.972	71	2.554
12	2.467	42	5.050	72	2.448
13	2.572	43	5.127	73	2.339
14	2.674	44	4.985	74	2.228
15	2.774	45	4.902	75	2.114
16	2.872	46	4.819	76	1.998
17	2.968	47	4.736	77	1.880
18	3.063	48	4.653	78	1.758
19	3.156	49	4.570	79	1.634
20	3.248	50	4.487	80	1.506
21	3.339	51	4.403	81	1.375
22	3.428	52	4.318	82	1.241
23	3.516	53	4.234	83	1.102
24	3.603	54	4.148	84	0.960
25	3.689	55	4.062	85	0.812
26	3.774	56	3.976	86	0.661
27	3.858	57	3.889	87	0.504
28	3.941	58	3.800	88	0.442
29	4.024	59	3.712	89	0.174
30	4.105	60	3.622	90	0.000

U

The

The Use of the Two Tables.

Question 1. If a Gun does carry a Shot, at 13 deg. of Mounture 763 Paces: What is the Horizontal Rainge of that Gun?

Look in the first Columb of the first Table, for 13 the degrees of Mounture, against which you shall find 3889, Multiply this number by 763, the Paces that the Gun carried at 13 deg. of Mounture, the Product will be 2967307, from which cut off four Figures towards the right hand and it will be 296. 7307: So that the Gun will carry at the Horizontal Rainge 296 Paces, and 7 Tenths of a Pace.

Also, If a Piece carries her Shot, at 16 deg. of Mounture 1074 Paces, the Horizontal Rainge of that Piece will be found to be 374 Paces.

Question 2. If a Gun carries a Shot 296 Paces and 7 Tenths of a Pace, at the Horizontal Rainge, how many Paces will she carry at 13 deg. of Mounture:

Look in the first Columb of the Second Table for 13 (the degrees of Mounture) against which stands 2.572, this number multiplied by 296.7 (the Horizontal Rainge of the Piece) the Product will be 763.1124, from which cut off 4 Figures, and it will be 763. 1124, that is 763 Paces, and so far will that Gun carry its Shot at 13 deg. of Mounture, which is answerable, and proves the foregoing Question.

In like manner you may find, That if a Gun at its Horizontal Rainge carry her Shot 374 Paces, at 16 deg. of Mounture it will convey her Shot 174 Paces.

Question 3. If a Piece carry her Shot 543 Paces at 11 degrees of Mounture, how far will she convey her Shot at 19 deg. of Mounture?

Multiply the number standing against 11 in the first Table, which

which is 4237, by 543 (the Rainge at 11 deg. of Mounture) the product will be 2300691. Then multiply this product by 3.156 (the number standing against 19 in the second Table) and this second product will be 726.0980796, from which seven figures being cut off towards the right hand, the remainder will be 726, and so many Paces will the Rainge at 19 deg. of Mounture,

And thus, If a Piece at 6 deg. of Mounture convey her Bullet 132 Paces, you shall find that at 12 deg. of Mounture she will convey it 181: 75 Paces:

C H A P. XXVII.

How you may make a good Shot at your Enemies Light in a dark night.

TO perform this, dispart your Piece, with a piece of lighted Match, then bring your Gun, so that you may see the top of the Metal at the Breech of the Piece, the coal of the Match, and the Light you are to Shoot at, all in one Right Line; Which done, give Fire.

C H A P. XXVIII:

How to make a perfect Shot in a dark night, at any mark (within the reach of the Piece) that you can see in the day time.

Mount your Piece to the Mark in the day time (as is before directed) and set down at what degree of Mounture it is elevated, then cut a strait stick which shall reach from the middle of the Mouth of the Piece, perpendicularly down to the Platform, where make a Mark: Also, cut another stick which shall reach from the middle of the Breech of

the Piece to the Platform, and there make another Mark, through which two Marks draw a right Line, extending it 4 or 5 Foot beyond the Marks, which call, *The Line of direction*. Then in the night Season, Load your Gun with such quantity of Powder and Weight of Shot, as you know your Gun will carry to the Mark, then bring your Gun just over the Line of Direction, and by help of your two Sticks, you may bring it to the like elevation it was in the day time. All this being done, Prime and give Fire.

CHAP. XXIX.

How to make a good Shot at a Company of Souldiers passing by; or at a Ship sailing up a River.

THe Gun being Charged with its due quantity of Powder and Shot, and upon a Level *Rainge*, right against some Mark (as a bush Tree, &c.) between which, and the Gun, the Souldiers are to March, then when the Souldiers begin to hinder your Sight from the March you before observed, give Fire; and doubtless you will do good Execution.

Also, to level at a Ship Sailing up a River, the Gunner must elevate his Piece by some Cloud (if he have not some eminent Mark on the other Side of the River) and when the fore part of the Ship shall come to be against the Mark, immediately give Fire.

CHAP. XXX.

Some Reasons, Why one and the same Piece of Ordnance at the same Elevation, charged with the same quantity of Powder, and directed to the self same Mark, and discharged several times, shall have different Rainges.

FOr farther satisfaction in this particular. I must refer my Reader (as I said at the beginning hereof) to such Authors

thors as have particularly discoursed of the Philosophical reasons hereof; As to Mr. Digs in his *Pantometria* and *Stratiaticos*; Mr. Smith, Mr. Bourne, Mr. Norton, Nicholas Tortalia, and of late experimented by a painful man, in finding out the reasons of these *Experiments*, my loving Friend Mr. Robert Anderson; But shall here insert an *Experiment* made by Mr. Nat Nye sometime Mr. Gunner of the City of Worcester, which take as followeth, *viz.* I have (saith he) discharged a Piece seven times in the space of 50 minutes with the like Weight of Powder, Shot, and Elevation, and have found their *Rainges* as followeth, *viz.*

The	{	First	}	Shot was Conveyed	{	416	}	Paces.
		Second				436		
		Third				440		
		Fourth				432		
		Fifth				425		
		Sixth				410		
		Seventh				394		

So that the greatest difference from the first Shot was about 24 Paces.

The Reason of these things is this. At the First Shot, the Bullet found the Aire quiet. — And at the Second Shot, it did not only find the Aire stirred with the first Shot, but also tending towards the place at which it Shot, and because it is more easie to move and penetrate that which is already moved and open, then that which is close and quiet, it followeth that the Second Shot, finding in its Rainge a lesser resistance then the first did, it did out Shoot the first.

A Second Reason is, At the first Shot the Powder being put into the Piece, doth oftentimes find the same somewhat moist, by which means the Powder will not fire quickly, as when the Piece is dry, and temperately warm, for this warmth, will somewhat dry up the moisture which is in the Powder, and cause it to fire sooner, wherefore the Powder doth not work so forcibly in the first Shot, as it doth in the second

the Piece to the Platform, and there make another Mark, through which two Marks draw a right Line, extending it 4 or 5 Foot beyond the Marks, which call, *The Line of direction*. Then in the night Season, Load your Gun with such quantity of Powder and Weight of Shot, as you know your Gun will carry to the Mark, then bring your Gun just over the Line of Direction, and by help of your two Sticks, you may bring it to the like elevation it was in the day time. All this being done, Prime and give Fire.

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The	{	First	Shot was Conveyed	{	4167	} Pages.
		Second			436	
		Third			440	
		Fourth			432	
		Fifth			425	
		Sixth			410	
		Seventh			394	

So that the greatest difference from the first Shot was about 24 Paces.

The Reason of these things is this. At the First Shot, the Bullet found the Aire quiet. — And at the Second Shot, it did not only find the Aire stirred with the first Shot, but also tending towards the place at which it Shot, and because it is more easie to move and penetrate that which is already moved and open, then that which is close and quiet, it followeth that the Second Shot, finding in its Rainge a lesser resistance then the first did, it did out Shoot the first.

A Second Reason is, At the first Shot the Powder being put into the Piece, doth oftentimes find the same somewhat moist, by which means the Powder will not fire quickly; as when the Piece is dry, and temperately warm, for this warmth, will somewhat dry up the moisture which is in the Powder, and cause it to fire sooner, wherefore the Powder doth not work so forcibly in the first Shot, as it doth in the second

second. — The Third and Fourth Shots will be much like the Second. And now I will give you the reason, why as the Piece grows hotter, one Shot will not exceed the last before it, but every time come shorter and shorter.

The Piece waxing hotter, and by how much the hotter, by so much the more attractive is the concavity of the Piece made; and because the Shot is driven forth, or expelled, with no other thing then by the airy exhalation, or wind caused through the Salt-Peter; therefore, by making such a Piece the more attractive with the more heat, which sup-
peth and retaineth continually more and more of that Wind which should serve to expel the Bullet; the vertue expulsive in that Piece, doth continually, more and more decrease, and the Shot flyeth not with that swiftness as it did before, although the two first things; that is, the breaking of the Aire, and the drying of the Powder every time more and more doth help much the Rainge of the Shot; which aid and help, as it is to be believed, that sometimes it supplyeth, and, perchance, gives advantage to that expulsive vertue which continually the Piece doth diminish or sup in, according as it heateth: So that the Third and Fourth Shots, will not be much differing from the Second Shot; nevertheless, in continuance of time, the said two accidents (that is, the opening of the Aire, and drying of the Powder by the heat of the Piece,) cannot supply the Third accident; that is, the vertue attractive, by reason, the attraction is augmented as the Piece heateth. And this caused my Sixth and Seventh Shots to convey the Bullet 22 Paces shorter then the First.

C H A P. XXXI.

Concerning Shooting in a Morter-Piece, and of several Fire-Works, both for Sea and Land Service.

Morter Pieces are made of the same Metal (Brass or Iron) as Ordnance are made of; in the making (or Casting) whereof these proportions are to be observed.

Suppose

Suppose the *Diameter* at the *Bore* to be
Nine Inches. Then

The Length of the *Morter* must be 18 Inches.

The *Chamber* in which you load with Powder 3 Inches *Di-*
ameter, and 4 Inches and a half deep.

The Thickness of the *Metal* about the *Touch-hole*, 3 Inches. And
The Thickness of *Metal* at the Mouth of the *Morter* one
Inch and a half

To Prepare Granadoes for a Morter.

The Diameter from out
to out of the Metal of a
Granado Shell, ought to be
one tenth part of an Inch
lesser then the Diameter of
the bore of the *Morter*, be-
cause of cording them to
fling into the Mouth of
the *Morter*, and also for
fear of secret *Cracks*, *Flaws*
or *Hony Combs*, which can-
not easily be discerned; let
them thus prepared, justly
fit the bore of the *Morter*.



To make Fuses for Granado Shells.

In every *Granado Shell*, there is a hole left to put in a *Fuse*,
or peece of wood in form of a *Fawlet* for a *Spigot*, which
hole is to be one quarter the Diameter of the wooden *Fuse*;
and the length of the *Fuse* must be about three quarters of the
diameter

Diameter of the *Granado Shell*, and made taper, and when filled with the *Composition* Following; it must be gently driven in amongst the Powder that is in the *Shell*, leaving a little of it without.

The Composition for the Fuse.

Take one Pound of Powder, four Ounces of Salt-Peeter, one Ounce of Brimstone, all beaten to Powder, and sifted severally through a fine Searse. These ingredients well mixed together, making your *Composition* fit for use.

How Granadoes are to be Charged in the Morter.

Great care ought to be taken in the Loading and Charging of the *Morter*, and for the safe and effectual performance thereof, observe these following *Directions*:

First, Weigh the Powder which you put into the *Chamber* very exactly, and after it put in a close wad of Hay; which done, cut up a Turf of the ground, that may fill the botome of the *Bore* or *Bore* of the *Morter*, next to the Wad, which is better than a *Tampion* of wood.

Secondly, Your *Granado* being prepared, sling it into the Mouth of the *Morter*; observing to have the *Fuse* of the *Granado* just in the Center of the Mouth of the *Morter*.

Thirdly, Go to the Breech of the *Morter*, and there thrust up a Wyre into the Touch-hole, to make all sure, and then prime it with good dry Powder, such as you may be sure will take Fire, for upon this, both your own Life, and the safety of the *Morter* (besides the disgrace) do depend.

Directions for Firing,

Provide small *Fuses*, of about one quarter of an Inch bore, three quarters of an Inch in thickness; and eight Inches long. Fill these with good Powder dust, moistned with Oyle of Salt-Peter, moisten it but a little, and put it in with an Iron

Rammer.

Rammer. Then try whether you like the time that they continue burning, and if you find they burn too slow, lessen your quantity of Oyle of Peter; but if too fast, adde more Oyle thereto.

All things being thus ready, Thrust the Pike of your *Lin-Flock* in at one end of the *Fuse*, you intend to give fire at; and bid one of your Assistants come on one side of the Mouth of the *Morter*, and give fire to your *Fuse*, wherewith fire the *Fuse* in the *Morter*, and then with speed give fire to the Touch-hole. It is far more certain to fire a *Morter-piece* with *Fuses* then with *Match*, which doth often fail.

How to Level the Morter Piece that it may make an effectual Shot at any Mark assigned.

You ought (as in finding the Rainges of other Pieces of Ordnance) to get leave to try One, Two or Three Shots for practice, without breaking of the *Shell*, which you may thus effect.

First, Fill the *Shell* with powder, then put it out again, and Weigh it exactly, and fill the *Shell* again with the like weight of Earth.

Secondly, Take a *Fuse*, and at the end of it tie 3 or 4 ounces of powder, which put down with the *Fuse* amongst the earth first making way for it by thrusting in a Staffe,

Thirdly, Level your *Morter* by help of a *Square* or *Quadrant* to (always) above 45 degrees, and what degrees you mount it to note down carefully.

Fourthly, All things being ready, and the *Shell* in and primed; cause One or Two to go and observe whether the *Fuse* burn all the while the *Granado* is flying, and when the 3 or 4 Ounces of powder takes fire, for hereby you may mend your *Fuse*, and try whether it will keep fire.

Fifthly, These things observed, Measure that distance, and note it down under the degrees of mounture, as also the Weight of the powder the *Morter* used to convey the *Shell* that distance. And when you have thus done two or three times

times, you may gain experience both of your *Fuse*, and of the true *Range* of the *Piece*: which obtained, if you are to storm a Fort or Castle

Sixthly, Take the distance to the Town, Fort, or other thing you are to shoot at, by which (and your former experiment) you may find at what degree of *Mounture* your *Mortar* is to be elevated to reach such a *Town*, or the like; and that by the *Reverse Rule of Proportion*: Thus:

As the distance when you made your trial,

Is to the degrees of the then *Mounture*;

So is the distance to your designed Place,

To the degrees to which the *Mortar* must be elevated to reach that designed Place:

E X A M P L E.

Imagin that you made your Experimental Shot at 46 deg of *Mounture*, and the Shell flew 320 Paces; how many degrees must the *Mortar* be elevated, to cast its *Shell* 280 Paces, the distance that the place you are to shoot at, is distant from the *Mortar*?

Multiply 320, by 46, the Product will be 14720, which divide by 280, the Quotient will be 52 Paces, and almost a half, and to so many degrees of *Mounture* must the *Mortar* be mounted to convey its *Shell* 280 Paces.

Some Cautions relating to the foregoing Section; concerning the Mortar-Piece.

1. Let your *Powder* (when you are to shoot often to the same place) be all of the same strength and goodness.
2. Use not *Tampions* of *Wood*, but a *Wad* of *Hay* and a *Turf* of *Earth*, both rammed in with the like strength.
3. Try your *Shells* before you fill them, by putting in a little *Powder*, and firing it, immediately stopping the *Fuse-hole* with *Clay*, for if any *Smoke* come out, the *Shell* is defective.

4. Weigh

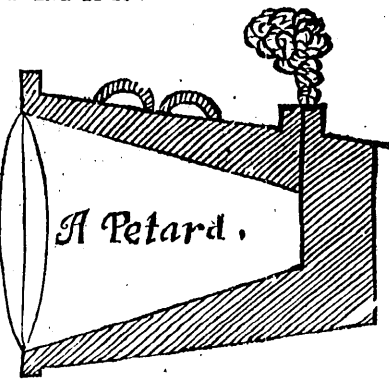
4. Weigh every *Shell* before you fill it, and make them all of one Weight, by putting in thereto so many *Musket Bullets* as will make their Weight even.
5. Fill your *heaviest Shell* with *Powder* (for that will contain least *Powder*) which done, pour it out again, and weigh it very exactly; for such a quantity (and no more) will serve all your *Shells*.

To make Granado's to be cast out of Mens Hands.

These small *Granadoes* are of no less esteem than the greater, either for Offence or Defence: To make them, First fill those small *Shells* with fine *Gun-powder*, then make *Fuses* of one Pound of *Gun-powder*, six Ounces of *Salt-peter*, and one Ounce of *Charcole*: Or if you would have them of less durance, you may make them of the *Composition* for Great *Granadoes*: Knock the *Fuse* up to the head within one quarter of an Inch, which is only to find it out by in the Night: Stop well the rest of the hole in the *Granado*, (and other flaws if any be) with soft *Wax*, then Coat it with *Pitch* and *Hurds* lest it should break with the fall; and be sure, that as soon as you have fired the *Fuse*, you cast the *Granado* out of your hand.

Of the P E T A R D.

These *Petards* are made of *Copper* and *Brass* mixed; and their dimensions are fitted according to the use for which they are prepared; there being three chief uses of them, and so many sorts there are, viz. some for blowing up and breaking of *Bridges*; others for *Gates* that have *Percullies* belonging to them; and the third sort for ordinary *Gates*



X 2

1. Those

1. Those for Bridges are commonly 11 Inches long, and at the breech seven Inches and a half about, and 5 Inches wide within; the Metal at the breech must be one Inch and a Quarter thick, and at the neck half an Inch thick, besides the Muzzel-ring; the mouth must be 10 Inches wide, and to the Touch-hole must be added a Pipe, as is in the Figure.

2. The second sort for Gates with Percussives, must be 9 Inches long, almost half an Inch thick at the neck, and an Inch thick at the breech, the mouth must be about 7 Inches wide, and the outside of the breech must be six Inches wide, and the inside four Inches.

3. The third sort, which is for Gates and Palisadoes, must be seven Inches long, one fifth part of an Inch thick at the neck, and three quarters of an Inch at the breech, the mouth must be 4 Inches wide, at the outside of the breech it must be 3 Inches and a half, and at the inside thereof 3 Inches.

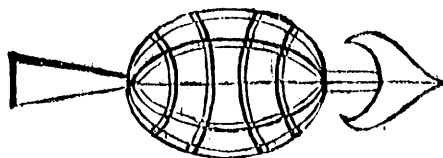
The Charges for these *Petards* are to be of the finest powder that can be got, beaten hard in the *Petard*, yet not to break the Gun, then must it be stopt close in with a Board of about an Inch thick, justly fitted thereunto with Wax melted to stop the Crivesses about to keep out water, you must not charge it up to the top, but leave the breadth almost of two Inches empty, which must be filled up with Tow close stopp'd in, and a linnen Cloth bound about the *Petard's* neck to keep it close in.

The Touch-hole must be stopp'd with a Cork, and over that a Sear-cloth to keep it from the Wet.

The Charge for this sort of *Petard*, is 5 or 6 pound of powder. Those of the second sort from 3 to 4 pounds. And for the smallest, from one pound and a half, to one pound.

To

To make Darts or Fire-Arrows



A Fire-Dart or Arrow.

Provide a long Staff, and joyn unto it an Iron head, and about the middle of that head of Iron, having first made a Bag of strong Canvas, in form of an Egg, leaving open at the end a hole to fill the Bag with the Composition following,

Take one Pound of Salt-peter, half a Pound of Gun powder, and as much Brimstone in Powder, mix all these together with Oyl of Petriol; with this Composition fill the Bag, round about the Arrow-head, and bind all about with nealed Wyre:

For the Priming of these Darts or Arrows, Dip Cotton-Week into Gun powder wet with water, and let the Cotton be well dried before you use it:

For the joyning of the Staff to the Arrow-head, let it be done very slightly, that the Arrow-head being fastned into any thing, those may be deceived that intend to pull out the Head, for they will pull out the Staff only.

How to make Fire-Wheels to be cast out of Mens Hands:

For the making of these, you are to use these Ingredients: Take four pound of Powder in Dust, one pound of Charcoal-dust, two pound of Tar; two pound of Salt-peter; and one pound of Rozen: All these Ingredients being well incorporated,



A Fire Wheel.

To make a Composition to fill Pikes, Darts, Javelines, Trunks, Balls, and other Fire-works; to defend a Ship or Breach, or to enter the same: Or to stick into the side of a Ship, or other Place.

Take of Powder bruised eight Pound; Peter in Roach one pound; Peter in Meal one pound; Sulphur in Meal two pound; Rozen three pound; Turpentine one pound; Vert-de-grease half a pound; Bolearmonick 5 Ounces; Bay Salt six Ounces; Colofonia 3 Ounces; Arsnick 2 Ounces. Mix these very well together: This Composition when fired will burn very furiously with a Blew and Greenish colour.

The Cases, Bags or Balls, which you fill with this Composition, must (when filled) be Armed about with strong Twine or Cord, and then covered over with this mixture, melted in a Pot.

Pitch 4 pound; Lin-seed Oyl one pound; Turpentine 5 Ounces; Sulphur one pound; Tar 5 Ounces; Tallow one pound.

Your Fire-works thus prepared are fit for service at any time; but when this outer Coating is cold, bore two holes with an Iron Bodkin, filling the same with fine Mealed Powder, putting in a small stick at each hole, which take out when you prime them for firing.

Fire

Fire-works made of the Composition, and Arming as afore-said, may be ordered so as to be thrown out of mens hands, shot out of a Musket, or out of a Cross or Long Bow; which may be of good use to fire Sails, Thatched Houses, Stacks of Corn or Hay, &c.

To make a Composition that will burn and feed upon the water.

Take of Mastick half a pound; White Frankincense, Gum Sandrake, Quick Lim^e, Brimstone, Camphire, Gun-powder, of each one pound and a half; Rozen one pound; Salt-Peter four pounds and a half: All these mixed together when fired will burn violently and feed upon the water.

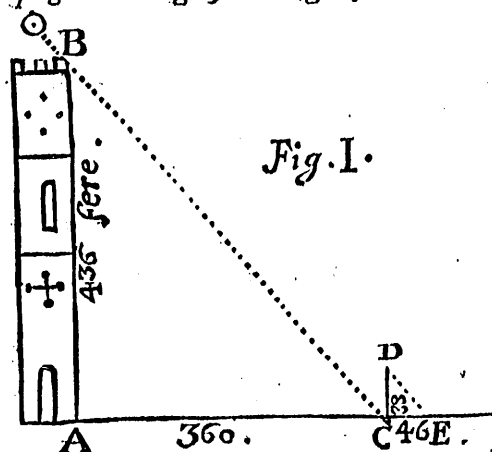
To make a Composition that will burn under the Water.

Take of Brimstone one pound; Gun-powder ten Ounces; Salt-Peter one pound and a half; Camphire beaten with Sulphur and Quick-silver: Mix these well together with Oyl of Peter, or Lin-seed Oyl boyled; fill a Ball or other Case of Wood, or Tin, with this Composition; Arm it as before, and ballast it with Lead at the bottom; make a small hole at the top, and fire it well and throw it into the Water.

F I N I S.

OF THE
MEASURING
 OF
Heights, Depths, and Distances.

- I. How to take the Height of a Tree, Tower, Steeple, or other upright Building, by the Length of the Shadow thereof.



Let B A be a *Castle Wall*, or the like, and the Sun shining casts the Shadow thereof upon plain ground to C, now having a *Walking-Staff* in my hand, I set that upright at the end of the shadow of the Wall at C, and I find, that my *Staff* casts its shadow to E, where I make a Mark, as also another at C, then measuring my *Staff*, I find it to be 38 Inches long, and measuring the length of the shadow thereof C E, I find that to be 46 Inches. Then I measure the length of the Shadow of the *Castle Wall* A C, and I find that to be 30 foot, which is 360 Inches

Fig. I.

Inches: Now for the height of the *Castle Wall*, you must work by the Rule of Proportion thus: Saying,

As C E, the *Length of the Shadow* of my *Staff* 46 Inches,
 Is in proportion to the *Length of Staff* C D, 38 Inches:
 So is A C, the *Length of the Shadow* of the *Wall* 360 Inches:
 To 435 $\frac{1}{2}$ Inches, for the height of the *Castle Wall*; which
 you may call 436 Inches.

For, If you multiply 46, the *Length of the Shadow* of the *Staff*, by 360, the *Length of the Shadow* of the *Wall*, the Product will be 16560, which being divided by 38, Inches the length of the *Staff*, the Quotient will be 435 $\frac{1}{2}$ Inches, which reduced into Feet is 36 foot 3 Inches and $\frac{1}{2}$ of an Inch which you may call 4 Inches, and so high is the *Castle Wall*:

- II. How to take the height of a Watch-Tower, by the Shadow, when you cannot come to the bottome of it, to measure the length of the Shadow.

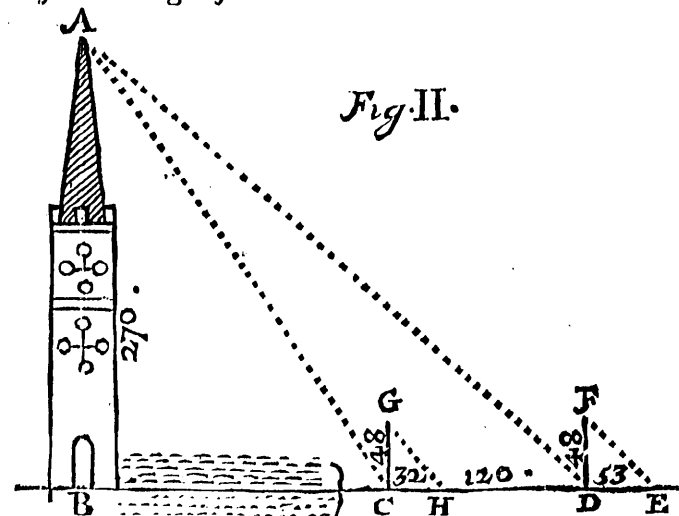


Fig. II.

Let A B, be a *Watch Tower*, whose height I would know, by the *Shadow* thereof, but there is a Moat about it, as

B C; so that I cannot come to measure the *Shadow* thereof; However,

I come near to the Moat side, and there I find the *Shadow* of the top of the *Tower* to cast at C, where I erect my *Staffe* C G, and that casts its *Shadow* to H; I measure the Length of my *Staffe*, and I find it 4 foot, or 48 Inches; and the Length of the *Shadow* thereof C H, I find to be 32 Inches, these two I note down.

Then, some time after, (when the Sun is lower) I come again to the place, and find the *Shadow* of the top of the *Tower* to cast at D, where again I erect the same *Staffe* of 4 foot long, and find that it casts its *Shadow* to E, and that the length of the *Shadow* thereof, D E, is 4 foot 5 inches, or 53 inches and somewhat better, this I also set down, and then I measure the distance between the two places where the *Tower* casts its *Shadow*, at the *First* and *Second* time of my *Observation*, namely, the distance C E, and find it to be 10 foot, or 120 inches.

And now having all these numbers set down, I come to find the *Height* of the *Tower* A B, by help of the *Rule of Proportion*, as followeth.

- (1) As D E, the length of the *Shadow* of the *Staffe* D F at the *Second Observation*, 53 Inches.

Is to 48 Inches, the length of the *Staffe*;

So is 10 foot (or 120 Inches) the Length of the *Shadow* between the two places of *Observation* C and D,

To 108 Inches, or 9 foot.

Which number 9 foot, or 108 Inches, set down

And say again by *Proportion*,

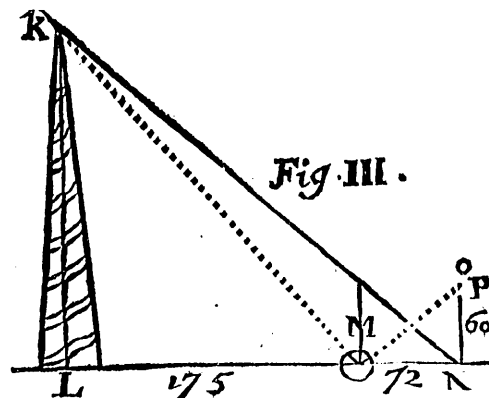
- (2) As 48 Inches the Length of the *Staffe* G C,
Is to 10 foot (or 120 Inches) the distance between the two places of *Observation* C and D;

So is 108 Inches (the Number before found)

To 270 Inches, the *Height* of the *Tower*, which reduced into Feet is 22 foot 6 Inches.

III. How

III. How to take the *Altitude* of any upright building, or the like, by a *Bowle* of Water.



TRavelling along the Road I see a *May-pole*, as K L, the height whereof I would gladly know, but having no *Geometrical Instrument*, I procure a *Bowl* of fair Water, which I set down upon the ground, at M. And then, when the Water is still in the Bowl, I go backward, in a right line from the *May-pole*, till I see the *Shadow* of the top of the *May-pole* in the middle of the Water; which I do when I come at N, and at N, I make a Mark upon the Ground: Then do I measure the distance from the foot of the *May-pole* at L, to the *Bowl* of Water at M, and find it to be 175 Inches: Also, I measure the distance from the *Bowl* of Water at M, to the place of my standing at N, and find that to be 72 Inches: Then I measure the *Height* of my eye from the Ground O N, and find that to be 60 Inches: These things known, I say by the *Rule of Proportion*.

If 72 Inches distance M N, give 60 Inches *Altitude* N O;

What *Altitude* shall 175 Inches the distance L M give?

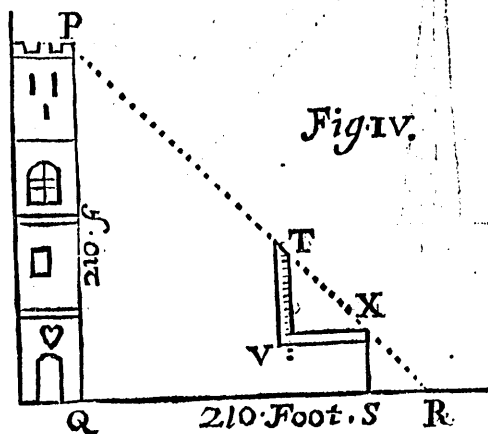
Answer 145 $\frac{6}{7}$ Inches.

Y 2

For

For, if you multiply 175 by 60, the Product will be 10500, which divide by 72, the quotient will be 145 $\frac{5}{12}$, that is almost 146 Inches, which is, 12 foot 2 Inches for the height of the May-pole K L, required.

IV. How to take the height of any upright Building, that is approachable, by two Sticks or Rulers joyned together, Square-wise.



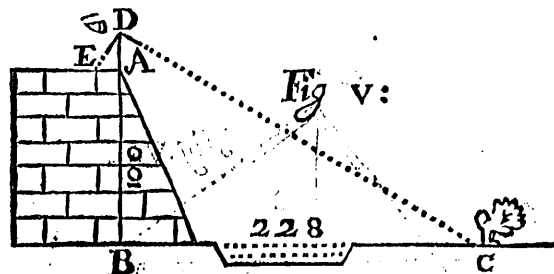
Let P Q be some Structure, standing upright upon plain Ground, whose height you require.

Go unto some convenient Court, Yard, Garden, or other piece of level Ground adjoining to the building to be measured, then take your Square in both your hands, holding it perpendicular, which you may do, by having a Thread and Plummet as T V, hung upon a pin near the top of the Square at T, Then keeping it in this posture, go backwards, or forwards, (as occasion requires) till your Eye being at X, you can see the other end of your Square at T, and the Top of the Building at P, all in one Right Line, which when you do, make a stand, as at S

Then

Then measure the height of your Eye from the Ground X S, with a string, and set that length upon the Ground from the place of your standing at S, to R: Then measure the distance from R, to Q, for that shall be equal to the height of the building P Q, and is here 210 foot.

V. How by help of this Square, standing upon a Platform of a known height, to find the distance from the Platform, to any Tree, River, or other Object that is remote from you,



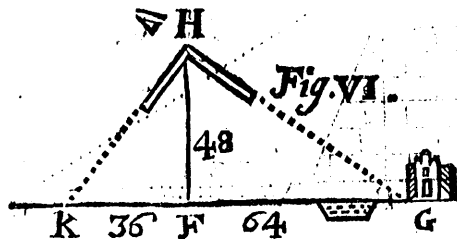
Let A B be a Platform, whose Perpendicular height is 100 foot, being upon the top thereof at A, I would know how far the Oake at C, is distance from the bottom of the Platform at B.

Upon the top of the Platform at A, I erect a Pike or Javeline 12 foot long, more or less, upon which, I hang the Angle of my Square: And I look with my Eye at D, along the side of my Square: till I see the bottom of the Oake at C, and in this position I fix my Square, with a Screw or the like, to the head of the Javeline: Then from D, I extend a thread or Line by the side of my Square, till it touch the Platform at E, and then I measure the distance upon the Platform from A to E, and find it to be 24 foot, 6 Inches, then by proportion I say

As

As 12 foot, the *Length* of the *Javelin* D A,
Is to 24 foot and a half, the distance measured upon the *Platform* A E,
So is 112, the height of the *Platform* and *Javelin* together
B D.
To 228 foot 8 Inches, for the distance B G.

VI. *How to take the distance from the place of your standing upon level Ground, to any Tree, Tower, or other thing, remote from you, though you cannot come neerer the same, by your Square.*



Standing at F, I see a *Coundit-head* at G, whose distance from F where I stand, I would know, but I cannot come neerer it for a *River* between F and G; However,

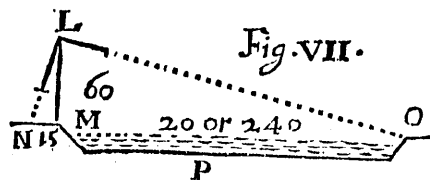
At F, I erect a *Staffe* of 4 foot high, (or 48 Inches) as FH, upon the end whereof I hang the *Angle* of my *Square*, and I look by the side thereof, till I see the foot of the *Coundit-head* at G, and fixing my *Square* there, I extend a line from H, by the side of the *Square*, till it touch the *Ground* at K: Then measuring the distance between F and K, I find it to be 3 foot or 36 Inches: Then by the *Rule of Proportion* I say,

As 36, the distance K F,
Is to F H, the *Length* of the *Staffe* 48 Inches:

So

So is 48 inches, the length of the *Staff* F H:
To 64 inches; for the *Distance* F G,
For as often, as K F, is contained in F H,
So often is F H, contained in F G.

VII. *How to take the Breadth of a River by the Square.*



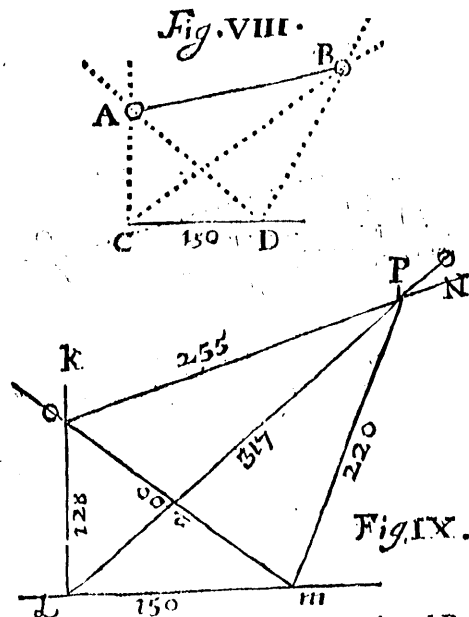
There is a *River* M P O, whose breadth I desire to know: Upon the brow of the *River* at M, I set up my *Staff* M L, which is 60 inches (or 5 foot) long, and hanging my *Square* upon the end thereof at L, I look by the *Side* thereof, till I see the *Brow* of the *River* on the other side at O, and there fixing my *Square*, I extend a *Thrid* by the *Side* thereof, from L to N, then measuring the distance L N, I find it to be 15 inches (or 1 foot 3 inches) then I say by *Proportion*,

As N M, the *distance* measured; 15 inches
Is to L M, the *length* of the *Staff* 6 inches.
So is L M 60 inches,

To M O, 240 inches, (or 20 foot, for the *breadth* of the *River* M O.

VIII. *How*

VIII. How to take the Distance between Two (or more) Places, without coming near any of them, by a Two Foot Joynt Rule.



Let the two remote Places given, be A and B, whose distance I would know, but I cannot approach, or come near either of them, and I have no other Instrument but my Two Foot Joynt Rule; however, I make choice of a Place at C, from whence I can see both the Places A and B, and there I set up a Staff whereon to rest my Rule, and opening it to a Square Angle, I look by one side of it, till I espie my first place, at A, and there keeping it fast, and level, I look by the other side of the Ruler, and cause a Mark to be set up in a right

right Line from C, at a competent distance from C, as at D, 150 foot, then close in your Rule, till by the side thereof you see your second place at B, keep your Rule at that Angle:

Then having a sheet of Paper, or upon a Board, as Figure IX. draw two Right Lines thereon, as K L, and L M, making a Right (or Square Angle) at L.

Then bring your Ruler, (it being still kept at the Angle it was when you looked to B,) and lay the Center of your Ruler upon L, and by the side of it draw a Line L M, and, because your measured distance between C and D was 150 foot, take 150 quarters of Inches (150 of any equal parts that you have upon your Ruler) and set them down upon your Paper or Board, from L to M.

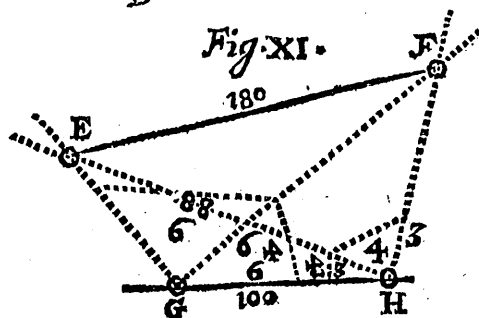
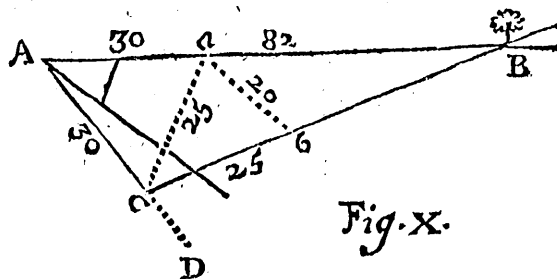
Then take your Rule and go to D, and set the Center of it upon the Staff, look by one side thereof to C, and by the other to A, then bring the Rule to the Board, and lay the Center thereof on M, and one side upon the line M L, and by the other side, draw a Line at length as the Line M O, crossing the Line L K in O, so shall O, upon your Board, represent the Place A in the Field: Again, take your Rule, and go to D, and there resting it upon the Staff, look by one edge to A, and by the other to B, and keeping it at that Angle, bring it to the Board, and lay one Side upon the Line M O, and by the other draw the Line M B, crossing the Line L N in the Point P, so shall P represent upon the Paper the Second Place B in the Field, and being measured upon the same Scale whereof L M was measured, it will be found to be 250 foot, and that is the distance from A to B. And by this means you may find the distances of all the Places in the Figure, if you measure them upon the same Scale as L M, or O P were measured, and so shall you find

The Distance $\left\{ \begin{array}{l} L O \\ L P \\ M O \\ M P \end{array} \right\}$ to Contain $\left\{ \begin{array}{l} 128 \\ 317 \\ 200 \\ 220 \end{array} \right\}$ Foot

Z

X. How

X. How to take the Distance between One or more Places, by a TenFoot Rod (divided into Inches) only:



Standing at A, I would know how far it is to the Tree at B, though I cannot come near it.

Though I cannot come near it.
Standing at A, I measure in a right Line from thence 30 foot, from A to *a*: And then looking towards D, I measure out 30 foot more, and from A to C; and measuring the distance *a* C, I find it to be 25 foot, which laid down upon Paper do make the Triangle A C *a*, of which draw the Line A *a* out at Length,

Then standing at C, I measure in a right Line towards B, 35 foot, from C to b, and the distance between a and b, I measure

measure to be 20 foot, which makes the Triangle Cab , Draw the Side Cb at Length, till it cross the former Line Aa , extended in B ; So shall the Line AB , (being measured by the same *Scale* that the other *Lines* were laid down by) be found to contain 82 foot, and such is the distance between A and B .

And according to this *Method*, may the *distances* from several Places be measured, As in Figure XI. Where standing at G and H, you may find the *distance* between E and F; and also, all the other intermediate distances, as from G or H, to E or F, as also the distances GE, GF, HE, HF, &c. as by the *Figure* is evident.

F I N I S.